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GLASSES

HOW SHOULD THE OPHTHALMOLOGIST WRITE HIS PRESCRIPTION?*

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Until comparatively recent times the commercially available shapes or forms of ophthalmic lenses were remarkably few. There was the choice between flat lenses and the 3, 6 and 9 base deep lenses. While the ophthalmologist recognized the superiority of the more deeply curved lenses over the flat forms, he seldom felt the necessity of specifying the particular shape with which he desired his prescription filled. Generally, the choice was left to the patient and the optician.

The fact that there were only two classes of lenses, with a marked difference in price, was perhaps an excuse for the attitude of the ophthalmologist; but the improvement and refinement of grinding machinery, the adoption of new devices and methods, have made possible the production of so many types of lenses that it seems the time has arrived when the conscientious prescriber must designate not only the best effective power, but also the best coflexure of each lens. The abundance of patented or copyrighted lenses, for which impossible claims are often made, makes this doubly necessary. Evidently in this plethora of lenses, all of different formula and curves, yet made of glass having the same index of refraction, there must exist a difference of merit. Any of these lenses is good, but if one is correct, all the others must be wrong. As a matter of fact, not one of them is perfect. The most accurate ophthalmic lens possible is still a compromise. Mathematical exactness, however, is unnecessary in an ophthalmic lens; any lens of reasonably good form will answer the requirements of a practically perfect ophthalmic lens.

In a paper read before the Guild of Opticians in New York in 1928[1] and in a subsequent paper read before the Section on Ophthalmology of the Baltimore Medical Society in 1929[2] reasons were offered supporting the use of the series of curves given in the table.

In this table the convex lenses up to 8 diopters have a constant back surface curve of —6 diopters; above 8 diopters, a front surface

* Submitted for publication, Nov. 29, 1930.

*Read before the Section on Ophthalmology of the College of Physicians of Philadelphia, Nov. 20, 1930.

1. Cowan, Alfred: Point-Focal Lenses, Guildcraft **1**:19 (Sept.) 1928.

2. Cowan, Alfred: The Newer Forms of Ophthalmic Lenses, Arch. Ophth. **2**:322 (Sept.) 1929.

curve of + 14 diopters is constant. By preference, the cylinders should be ground in the front convex surface, except in the high power lenses, which it is easier and more accurate to grind in the back surface—either concave toric or plain minus or plus cylinders.

The concave lenses have a constant inside curve of —6 diopters up to the —6 diopter lens, after which the inside curves are increased in order to maintain the planoconcave form. The cylinder, as in the convex lenses, is to be placed in front.

The sum of the spherical and cylindric components should be taken as the lens power in estimating the curves. When possible, it is best to have the same back surfaces for a pair of lenses; exceptions to this will be given later. It is not always possible or necessary to adhere strictly to the curves given. In the ordinary strengths, the

Good Form Lenses

Power in Diopters	Front Surface	Back Surface
Convex Lenses		
1	+ 7	—6
2	+ 8	—6
3	+ 9	—6
4	+10	—6
5	+11	—6
6	+12	—6
7	+13	—6
8	+14	—6
9	+14	—5
10	+14	—4
11	+14	—3
12	+14	—2
13	+14	—1
14	+14	Plano
Concave Lenses		
1	+ 5	—6
2	+ 4	—6
3	+ 3	—6
4	+ 2	—6
5	+ 1	—6
6	Plano	—6

back surfaces may vary between —4 and —5 diopters for strictly reading glasses, and between —5 and —8 diopters (higher for negative powers) for distance glasses, with a difference of less than 1 diopter between the back surfaces of the two lenses whenever possible. Different curves may be ordered when, without noticeable visual effect, the pair of lenses will have a better appearance or be less difficult to grind.

Each lens and each pair of lenses is a separate problem, and before writing his prescription, the opthalmologist should consider the finished glasses from the standpoint of effective power, coflexure, appearance and economy.

In order to cooperate with the optician, and at the same time give the best service possible to the patient, the ophthalmologist must be familiar with the practical side of the dispensing of glasses. First, it should be known that the optician keeps a certain number of finished or partially finished lenses in stock. Many of these lenses are of good

form, and whenever this is so they should be ordered. Next, while most well equipped optical shops can make tools for grinding almost any lens surface, it takes time to make special tools, and therefore the prescriber should prefer lenses that can be ground with stock tools.

At this place it might be well to consider roughly some of the ordinary standard lenses in general use at the present time. All, or most of these, in the ordinary powers, are usually kept in stock.

The flattest form of spherical lens is, of course, an equal-sided biconvex or biconcave lens. Equal-sided spheres, as well as planoconvex or planoconcave lenses, are so seldom used that they must be specially ground and are therefore expensive. The ordinary so-called flat or periscopic lenses are ground with a — 1.25 diopter base curve in convex and + 1.25 in concave. They are called flat, in order to distinguish them from the deeper forms of spherical lenses. Formerly they were cheaper than the menisci and convexoconcave lenses, but now that the deeper forms are almost universally used, the cost is about the same. A — 4.75 diopter spherical lens in the periscopic or flat form has a front surface of + 1.25 diopters and a back surface of — 6 diopters. A + 12.75, in this form, would have a back surface of — 1.25 diopters and a front surface of + 14 diopters. The coflexure of each of these lenses conforms to that given in the table.

The deeply curved spherical lenses, properly called menisci in the positive and convexoconcave in the negative powers, are usually made on a constant 6 diopter base curve, but may also be had in 9 diopter and 3 diopter base curves. The base is concave (constant — 3, — 6 or — 9 diopters) in the positive, and convex (constant + 3, + 6 or + 9 diopters) in the negative powers. For example, a + 3 diopter lens in a 6 base meniscus has a + 9 diopter front surface and a — 6 diopter back surface. A — 3 diopter convexoconcave lens of 6 diopter base has a + 6 diopter front surface and a — 9 diopter back surface. Most opticians keep a stock of 6 diopter curves, some carry 6 and 9 diopter curves, but very few have 3 diopter base curve spherical lenses on hand.

By flat spherocylinder is meant a glass having the spherical component on one side and the cylindric component on the other side. This is the cheapest form of spherocylindric lens.

The ordinary toric lenses have a toric front curve with a constant convex spherical power. This is for both positive and negative lenses. They are based, as a rule, on a spherical base of + 6 diopters, but some opticians carry a stock of + 9 base toric lenses. Very few carry lenses with + 3 diopter base curves. In these lenses, the sphere in the toric front being constant, the spherical power varies with the power of the back surface. It takes more time to grind the toric surface than it does to grind the spherical surface, and the optician may keep a stock of front surfaced toric lenses in the various cylindric

powers, so that by merely surfacing the easily ground back he can quickly supply a given spherocylindric combination. For example, in a 6 base toric lens, + 3 + 0.50 axis 90, the front surface is + 6 + 0.50 axis 90 and the back surface is — 3 diopters; in a — 3 — 0.50 axis 180, the front surface remaining + 6 + 0.50 axis 90, the back surface must be — 9.50 diopters. Toric lenses may be specially ground with the cylinder on the concave side if desired.

The reading portion of cement bifocal lenses may be made in any shape, but it should be remembered that it must be placed on the spherical side of the glass. It should also be remembered that it is desirable, for appearance, to have the segment on the inside. The optician always sets the lenses with the least convexity or greatest concavity toward the face, and in a flat mixed cylinder, + 2 — 4 axis 180, for example, either the segment must be in front or the lens must be placed inside-out. This lens should be transposed to — 2 + 4 axis 90 so that the segment and the concave side may be toward the face.

On account of the optical principles involved in fused bifocal lenses the near addition is placed on a spherical surface, preferably convex. The ordinary toric fused bifocal lenses, therefore, have the cylinders incorporated in the concave side in order that the reading portion may be placed in the front surface, but several widely advertised "best form" fused bifocal lenses in which the cylinders are ground in the front surface have the segments placed in the concave spherical surface. Fused bifocal lenses are usually made in + 4, + 6, + 8 or + 10 spherical fronts. The reading portion may be obtained in various shapes and sizes, centered as desired.

In the one piece bifocal lens, the segment must be ground on a noncylindric surface, preferably concave, and ordinarily it is so placed. This surface may be had in plano, — 4, — 6, — 8 or — 10 diopters. Also the segment may be, by special order, ground on a + 4 or + 6 convex surface for equal-sided or nearly equal-sided glasses for persons with cataract. The reading portion may be ground to a specified size and may be centered as desired, but it must always have the form of a segment.

The following selected examples of pairs and single lenses, and the form in which they might be prescribed, will serve to illustrate the treatment suggested:

O.D. + 3 + 0.25 axis 90
O.S. + 3

In the flat form, this pair of glasses would have for the right lens a + 0.25 cylinder toward the face and a + 3 diopter sphere in front. The left lens (periscopic) would be — 1.25 diopters toward the face and + 4.25 diopters in front. If the ordinary toric lenses are ordered, the right will have the standard + 6 + 0.25 cylinder in front and a — 3

diopter sphere in back. The left lens will have — 6 diopters for the back surface and + 9 diopters for the front. To be symmetrical, they should be ordered in this way:

O.D. + 3 + 0.25 axis 90 (+ 9 base toric)
O.S. + 3 (— 6 base meniscus)

so that — 6 diopters is ground in each back surface.

O.D. + 2.50 + 0.50 axis 90

In the ordinary + 6 diopter base curve toric lens, this would have — 3.50 diopters in the back surface, a good form if used for reading only. It would be better, however, to order a + 9 base toric lens—back surface — 6.50— if the glasses are meant for constant use.

O.D. + 4.50
O. S. + 3.50 + 0.75 axis 90

The right lens of this pair of glasses, in the ordinary + 6 base meniscus, would have a — 6 diopter back; the left, in the ordinary toric lens, would have a — 2.50 diopter back. This is not good. If the toric lens for the left eye were ground in + 9 base, it would have — 5.50 diopters back; this lens with an ordinary meniscus lens with a — 6 diopter back for the right eye would make a good pair of glasses. For a slight additional cost, however, the left lens could be specially ground with a — 6 diopter back surface, making both back surfaces the same.

+ 1.50 + 3 axis 90

The + 6 base toric lens would have a — 4.50 diopter back surface, and the + 9 base toric lens would have a —7.50 diopter back surface. It would be best to order a specially ground — 6 diopter sphere on the inside.

+ 6.50 + 1 axis 90

The back surface here would be + 0.50 diopter in the + 6 base toric lens and — 2.50 diopters in the + 9 base toric lens. It would be best to order — 6 diopter back.

+ 11 + 3 axis 180

Probably the best and cheapest form of this lens for persons with cataract would be obtained if the prescription were written:

+ 14 — 3 axis 90 (do not transpose)

In the following perscription:

— 3 — 3 axis 180

if this glass were ground in the ordinary + 6 base toric lens the front surface would be + 6 + 3 axis 90 and the back surface would be a — 12 diopter sphere. A mixed cylinder, written:

— 6 + 3 axis 90 (do not transpose)

would be not only a cheaper but a better lens. The same may be done for all concave lenses in which the sum of the powers of the spherical and cylindric components can be utilized; for example,

$$-4.50 -1 \text{ axis } 180$$

written

$$-5.50 +1 \text{ axis } 90 \text{ (do not transpose)}$$

will be useful, good looking and economical. Again,

$$-6 \text{ axis } 180$$

in a toric lens, would not be as good nor nearly as cheap as the flat mixed cylinder

$$-6 +6 \text{ axis } 90 \text{ (do not transpose)}$$

In the following perscription:

$$-2.50 -0.50 \text{ axis } 180$$

this glass would be best in a + 3 base toric lens, in which the front surface would be + 3 + 0.50 axis 90 and the back surface — 6 diopters

$$\text{O.D. } -0.50 -4.25 \text{ axis } 180$$
$$\text{O.S. } -1 -3.25 \text{ axis } 180$$

It would probably be better to note under this prescription "O_2 grind back surfaces — 6 D. sphere," but 3 base toric lenses (back surfaces O.D. — 7.75, O.S. — 7.25) would make a good pair of glasses; or flat cylinders transposed to

$$\text{O.D. } -4.75 +4.25 \text{ axis } 90$$
$$\text{O.S. } -4.25 +3.25 \text{ axis } 90$$

may be given to dispensary patients and others to whom the price is a serious consideration.

In cases of high myopic astigmatism, either

$$-10 -2 \text{ axis } 180$$
or
$$-12 +2 \text{ axis } 90$$

may be given. One is probably as good as the other, although the last might be a better looking lens.

$$\text{O.D. } +1.25 +0.25 \text{ axis } 90$$
$$\text{O.S. } -1.25 -3.50 \text{ axis } 180$$

If these glasses were made with + 6 base toric lenses for each eye, the back surface of the right would be — 4.75 and that of the left — 10.75. The prescription would be better if written:

$$\text{O.D. } +1.25 +0.25 \text{ axis } 90 \quad (+9 \text{ base toric})$$
$$\text{O.S. } -1.25 -3.50 \text{ axis } 180 \quad (+3 \text{ base toric})$$

so that each back surface will be — 7.75. If cement bifocal lenses were desired, the reading segments could be placed on the inner concave

spherical surfaces; in one piece bifocal lenses, the ordinary — 6 spherical base may be ordered, and in fused bifocal lenses, the + 10 front in the right lens and the + 4 in the left would be best. For this prescription either the cement or the one piece bifocal lens would probably be better than the fused.

These examples are meant only as suggestions, not rules. The real purpose of this paper is to urge the ophthalmologist to designate in his prescription the exact form of the lenses.

CALCIUM IN RELATION TO CATARACT

I. IN VITRO *

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The study of cell life and metabolism in the living human eye has great possibilities, but direct observation of the reactions of cells can be made only with the lower magnifications. Even this has proved a great boon, as accomplished with the aid of the slit-lamp microscope. Much has been learned through studies of histology and pathology. Much more remains to be learned of the complex chemical relations existing in the cells and the humors of the eye by working with living material in vitro.

The crystalline lens seems to be particularly adapted to in vitro experiments, because, of all the tissues of the body, the conditions surrounding it in vivo most closely simulate those which may be produced in vitro. Suspended as it is between the aqueous and vitreous, it is dependent for its nutrition not on the direct circulation of blood but on a process of endosmosis, exchanging materials, chiefly with the aqueous humor. Here, then, are conditions that may be copied and that will make for valid experiments on the nutrition and metabolism of the crystalline lens: (1) the production of a true and complete synthetic aqueous humor; (2) the use of the living crystalline lens removed without trauma from animal eyes and set up in such a way in vitro that its continued life is possible, and (3) circulation of the synthetic aqueous about the lens in vitro to supply nutrition and to carry off waste products. Much will be gained when such conditions are produced. The most important feature lies in the maintenance of the vital factor and its influence on the metabolic processes.

I have been successful in continuing the life and transparency of the chick embryo lens for short periods in vitro, but have not been able thus far to reproduce a true and complete aqueous humor nor to simulate perfectly the anatomic conditions that exist in vivo. The life of the epithelial cells removed from the lens can be carried on for months in vitro.

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* From the Department of Ophthalmology, College of Physicians and Surgeons, while the author was Research Fellow for The American Academy of Ophthalmology and Oto-Laryngology.

Experiments designed to show the action of calcium on the epithelial cells of the living lens in vitro have been performed. My object in this paper is to deal with this subject.

THE ACTION OF CALCIUM SALTS IN VITRO

Friedenwald [1] found that calcium decreased the permeability of the lens capsule, which normally in vivo, he stated, acts as an inert, semipermeable membrane. He concluded from other experiments that only a relatively slight reduction in the permeability of the lens capsule is required to obstruct the metabolic processes of the lens sufficiently to cause cataract. This conclusion, he stated, together with other data, justified the theory that some forms of senile cataract are caused by an exaggeration of the decrease in the permeability of the lens capsule which normally takes place with increasing age.

Duke-Elder was quoted by Adams [2] as accepting the fact that solutions of calcium salts have no action on fresh animal lenses in vitro except in concentrations far exceeding the physiologic range. Duke-Elder quoted Stoeltzner, who found that pig lenses became clouded only on the addition of 3.337 per cent calcium chloride to isotonic sodium chloride, and Nelson who found that 2.25 per cent calcium chloride was the lowest concentration at which clouding occurred.

Adams immersed fresh ox lenses without capsules in solutions of calcium chloride which had been buffered to the normal body p_H 7.5 with 0.001 sodium hydroxide or with Ringer's solution. The solutions ranged from 0.025 to 5 per cent calcium. From 0.7 per cent upward the lenses showed very superficial areas of cortical opacity which increased in extent according to the concentration of calcium. These seemed to be only a precipitation of calcium on the bare cortex. Some changes occurred more slowly in lenses with capsules. Only in solutions above 2.5 per cent calcium did a definite cortical opacity develop which appeared to be a true coagulation of lens protein.

THE SENSITIZING OF LENS PROTEIN TO ULTRAVIOLET LIGHT BY CALCIUM

Burge [3] found that: 1. Radiation from a quartz mercury vapor lamp that is sufficiently intense to coagulate egg albumin, egg globulin, vitellin, serum albumin and serum globulin in one hour does not coagulate the protein of the normal lens or of the vitreous or aqueous humors,

1. Friedenwald, J. S.: Permeability of Lens Capsule, with Special Reference to the Etiology of Senile Cataract, Arch. Ophth. **3**:182 (Feb.) 1930.

2. Adams, D. R.: Biochem. J. **23**:902, 1929.

3. Burge, W. E.: Am. J. Physiol. **36**:21, 1914-1915.

and hence does not affect the transparency of these structures after a continuous exposure of 100 hours. The region of the ultraviolet spectrum effective in coagulating the egg white lies between 265 and 302 mm. The most effective region lies around 265 mm. 2. The lens protein can be modified by solutions of calcium chloride and other substances too weak of themselves to affect the transparency of the lens so that ultraviolet radiation can precipitate the modified lens protein and hence produce opacity of the lens. The effective region in case of modification by calcium chloride is from 265 to 302 mm., inclusive. The most effective region lies around 265 mm. 3. Analyses of senile cataractous human lenses show that calcium and magnesium are greatly increased, while in cataracts from India the silicates are greatly increased. The assumption is made that the accumulation of these substances modifies the lens protein in such a way that the ultraviolet waves of the spectrum can precipitate the protein, thus producing opacity or cataract.

Burge found the amount of calcium in normal lens too small to estimate. By modern microchemical methods it can now be accurately measured. Adams found 0.0516 Gm. per hundred grams of dry weight in the normal adult lens. This amount is small but just proper for balance with other ions and molecules. There is an irreducible minimum necessary for the health and well being of ectodermal tissues. While the lens remains normal and transparent, the calcium content is not increased. This comes on in the cataractous lens only secondary to other changes in the tissue. Therefore, it would seem that some factor other than excess calcium initiates the cataractous process.

THE ACTION OF CALCIUM ON LENS PROTEIN

Adams prepared a dialyzed solution of the alpha crystallin in the lens protein according to the method that she described in 1925, and found a fine flocculation proportional to the amount of calcium salt that she added to it. Then, acting on Burge's conclusions, she exposed these solutions to ultraviolet radiation for thirty minutes and found marked flocculations of both alpha and beta crystallin solutions in the presence of calcium salt.

As Adams pointed out, these observations are undoubtedly not strictly applicable to the changes that occur in vivo. They are related to the whole problem of the denaturation and agglutination of colloidal solutions. The fact that they are extremely labile in vitro makes it all the more remarkable that they remain constant in vivo. The lens protein present in the lens fibers must be regarded as a colloidal solution with a predominance of alpha and beta crystallin proteins in youth. As age progresses, these are removed from the lens and replaced by

insoluble albuminoid without loss of volume of the lens. Care must be taken, therefore, in applying to the eye and lens of the elderly subject conclusions drawn from in vitro experiments with alpha and beta crystallin in which the vital process is not at work, even though it is true that a small proportion of soluble protein remains in the lens of the elderly and is found in the outermost cortex where the changes of senile cortical cataract are most common.

It has been my opinion for some time that the vacuoles, water splitting of sutures and separation of the lamellae of the lens in cortical cataract represent a breaking down of the complicated colloidal solution of the cortical protein with extrusion of the water molecule from the large lens protein molecule.

Calcium and its salts are undoubtedly of great importance in stabilizing any colloidal solution, and in this rôle are of prime importance in the crystalline lens. It seems to be true that there is a certain optimum range, within narrow limits, which is maintained by the vital process. Decreases in calcium produce pathologic changes in the lens tissue, while increases up to the physiologic limits of the body, even to certain levels of hypercalcemia, do not have any bad effect on the lens in vitro or in vivo.

EXPERIMENTS WITH LIVING EPITHELIAL CELLS OF THE LENS IN VITRO

In 1926, I [4] reported successful results in explanting and carrying on cultures and subcultures of lens epithelium through repeated generations. In 1928, continued cultivation of the lens cells for a period of seven months with voluntary discontinuance during the summer was recorded.[5] It was shown that it was possible to remove the lens in its capsule from the eye of the 5 day chick embryo, to incubate it in proper medium for twenty-four hours and then to remove the epithelial cells and cultivate them in unmixed strain without contamination by other cells through a number of generations. It was shown that in order to draw valid conclusions from this work, controlled experiments on similar or related cultures of cells must be made. The epithelium of the lens forms such a delicate tissue that it is not possible to divide one single culture, as Carrel did with fibroblasts. It was found that single cultures which grow in similar fashion through a number of generations are suitable for experimental purposes.

Results were judged each forty-eight hours on the condition of the individual cells, their relation to each other, and the relative size, shape,

4. Kirby, D. B.: A Study of the Nutrition of the Crystalline Lens: The Cultivation of Lens Epithelium in Vitro, Tr. Am. Acad. Ophth. **31**:137, 1926.

5. Kirby, D. B.: Tr. Am. Acad. Ophth. **33**:148, 1928.

thickness and transparency of the entire culture. The presence of a halo of transparency about the extensions of the cultures was regarded as normal in that it represented the preparation of the medium by the cells for ingestion or the effect of excretory products extruded by the cells. Further digestion and liquefaction of the medium was distinctly abnormal and was looked on as a reaction to deleterious influences. Vacuolation or vesiculation of the cytoplasm of the cells, withdrawal of the fine filamentous processes or rounded herniations of the cytoplasm with loss of line contour of the individual cells, and loss of apposition of cells which in normal epithelial growth tend to resemble a syncytium were taken as evidence of toxic influences. The cells while dying lost contact with each other, and when dead, appeared like opaque spherules, apparently much smaller than in the living state.

In 1928, in reporting the effects of various factors on lens epithelium in vitro, the estimation of the relative two dimension surface size of the growth alone was taken as the sole criterion for comparing the experimental with the control culture, but it is felt now that the evaluation of the additional factors mentioned has proved to be more accurate.

Improvements in Technic.—Improved methods will make for better experiments in the future. Handling and cutting the tissues, unless done under magnification, often leads to trauma, which is bound to be a variable factor. Continued life of cells without transfer is desirable. This is to be accomplished by the Maximov double slide method, by the Carrel flask method, and by the Carrel continuous circulation device which provides a constant renewal of the nutrient material and removal of the excretory products of the cells without any necessity for touching the cells. These methods are difficult and are not yet perfect, but they should be excellent for experimental work. The conclusions in each of the following experiments were based on the results obtained with six separate cultures, three experimental and three control. If the control cultures were not uniformly good, the experiment was discarded.

EXPERIMENTS ON THE CALCIUM CONCENTRATION OF THE MEDIUM

A study of the effect of varying concentrations of calcium on the living lens epithelial cells in vitro was undertaken.[6] This element was selected because of interest in connection with a parallel study, that of the relation of calcium to cataract in vivo.

It had been found that chick embryo lens epithelium grew best for controlled experimental purposes in a medium composed of one part of adult chicken plasma, one part of 9 or 10 day chick embryo extract and one part of Tyrode's solution. The preparation of the plasma

6. Keith C. Estey and Clarissa Kibbe aided in carrying on the cultivation and experimental work with lens epithelial cultures.

and the extract is described in Fischer's Text-Book.[7] The formula for Tyrode's solution is as follows: sodium chloride, 8 Gm.; potassium chloride, 0.20 Gm.; calcium chloride, anhydrous, 0.20 Gm.; magnesium chloride, 0.10 Gm.; monosodium phosphate, 0.05 Gm.; sodium bicarbonate, 1 Gm.; dextrose, 1 Gm., and distilled water, 1,000 cc.

The amount of calcium in the control medium was subject to variation, according to the fluctuations in the content of the embryonic juice and of the blood plasma. It is therefore impossible to give the exact content of the medium in any individual experiment. The results of the experiments are thus comparative only and cannot be said to represent an absolute reaction to a given content of calcium. This is unfortunate but true. The most variable factor is the embryonic juice. The calcium content of the embryo body varies according to the state of development. In these experiments, only 9 or 10 day embryos were used, and every effort was made to have the extract exactly the same each time.

The medium made up in this manner was known as the normal or control medium. In the original experiments, lens epithelium was often grown in a mixture of plasma and embryo extract alone. It was found, however, that the concentrated extract was not necessary; it could be diluted with Tyrode's solution, as Carrel did with fibroblasts, and equally good results obtained.

In the preparation of the experimental medium the plasma and the embryo juice used in any test were the same as those used in the control medium. The experimental aqueous solution replacing the Tyrode solution was the variable factor, being made with the same quantities of all the constitutents except calcium. This was used in greater or lesser proportions to obtain the desired experimental concentrations. In selected experiments the potassium was varied with the calcium, as it was known that the calcium-potassium ratio was important in any medium or solution of this nature.

In producing the change in calcium content of the experimental medium, the amount put into the synthetic aqueous solution is varied. As this is added to equal parts of plasma and embryonic extract, the increased or diminished amount of calcium is divided between the three parts on mixing them. The increase or decrease is figured down to milligrams above or below the content of the normal or control medium. The calcium is added in the form of anhydrous calcium chloride, so that the atomic and molecular weights have been considered in calculating the proportion of the element itself.

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7. Fischer, A.: Text-Book of Tissue Culture, ed. 1, Copenhagen, Levin & Munksgaard; Gewebezuchtung, ed. 2, Munich, R. Müller, 1927.

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The amount of calcium in the control medium was subject to variation, according to the fluctuations in the content of the embryonic juice and of the blood plasma. It is therefore impossible to give the exact content of the medium in any individual experiment. The results of the experiments are thus comparative only and cannot be said to represent an absolute reaction to a given content of calcium. This is unfortunate but true. The most variable factor is the embryonic juice. The calcium content of the embryo body varies according to the state of development. In these experiments, only 9 or 10 day embryos were used, and every effort was made to have the extract exactly the same each time.

The medium made up in this manner was known as the normal or control medium. In the original experiments, lens epithelium was often grown in a mixture of plasma and embryo extract alone. It was found, however, that the concentrated extract was not necessary; it could be diluted with Tyrode's solution, as Carrel did with fibroblasts, and equally good results obtained.

In the preparation of the experimental medium the plasma and the embryo juice used in any test were the same as those used in the control medium. The experimental aqueous solution replacing the Tyrode solution was the variable factor, being made with the same quantities of all the constitutents except calcium. This was used in greater or lesser proportions to obtain the desired experimental concentrations. In selected experiments the potassium was varied with the calcium, as it was known that the calcium-potassium ratio was important in any medium or solution of this nature.

In producing the change in calcium content of the experimental medium, the amount put into the synthetic aqueous solution is varied. As this is added to equal parts of plasma and embryonic extract, the increased or diminished amount of calcium is divided between the three parts on mixing them. The increase or decrease is figured down to milligrams above or below the content of the normal or control medium. The calcium is added in the form of anhydrous calcium chloride, so that the atomic and molecular weights have been considered in calculating the proportion of the element itself.

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7. Fischer, A.: Text-Book of Tissue Culture, ed. 1, Copenhagen, Levín & Munksgaard; Gewebezuchtung, ed. 2, Munich, R. Müller, 1927.

Ordinarily when the concave slide and cover-slip method of Carrel is used, the cultures require a change in medium every forty-eight hours. This necessitates removal of the culture from the medium by cutting it with a sharp cataract knife, washing it in Tyrode's solution and transferring it to a fresh medium. This was done, and the experiment was continued through as many passages as were necessary to draw a logical conclusion. It would be improper to judge from the effects of a single passage as the effects of a slightly toxic agent are cumulative and appear only after three, four or more passages into a fresh medium.

EFFECT OF CHANGE IN CALCIUM CONTENT OF MEDIUM ON LENS EPITHELIUM IN VITRO

Increase in Calcium.—EXPERIMENT 13.—The experimental medium contained 1.9 mg. of calcium per hundred cubic centimeters more than the control medium. No difference was observed in cultures after forty-eight hours.

EXPERIMENT 19.—The calcium content of the experimental medium increased 3.5 mg. per hundred cubic centimeters. There was no difference in the cultures.

EXPERIMENT 34.—The calcium content increased 4.43 mg. per hundred cubic centimeters. In this experiment, the calcium was reduced in the control medium. This was done in order to have a relatively large increase in the experimental medium without danger of precipitation of calcium. It was found difficult to hold larger amounts of calcium added to Tyrode's solution in solution in the medium. The calcium was dissolved in distilled water (0.05 Gm. to 100 cc.) and in this form added to the experimental medium. It was thus possible to avoid precipitation, and the cultures were carried along for twelve days without a marked difference from the controls.

EXPERIMENT 52.—In this experiment, conditions were different than in experiment 34. The control medium had a normal calcium content. Hence an increase of 4.8 mg. of calcium per hundred cubic centimeters over the control represented an absolute value greater than in the preceding experiment. Extra calcium was added to the Tyrode solution to obtain the increase. Precipitates formed in the solution on three different trials. They were also noted in the culture medium after it was mixed. After three passages in six days, two of the experimental cultures were dead and two others were in poor condition.

Decrease in Calcium.—EXPERIMENT 79.—A decrease of 0.47 mg. of calcium per hundred cubic centimeters produced no difference in ten days through four passages.

EXPERIMENT 144.—A decrease of 0.83 mg. of calcium per hundred cubic centimeters gave the same result.

EXPERIMENT 71.—A decrease of 1.08 mg. of calcium was produced in the experimental medium. After four passages all the experimental cultures were dead, while the controls, though not very good, were still active. Some additional slightly toxic factor was at work on both experimental and control cultures.

EXPERIMENT 137.—A decrease of 1.44 mg. of calcium produced poorer growth on the part of experimental cultures. They were still living, however, after three passages in seven days.

EXPERIMENT 142.—The calcium was decreased by 1.8 mg. One experimental culture was dead after four days, and another after six days; the remaining two were in poor condition.

EXPERIMENT 44.—This medium was prepared by diluting the experimental medium with distilled water. After four days, two cultures were dead. In another three days, still another culture died and the fourth was dead four days later. The controls did well even though the growth was not as large as normal.

Comment.—Lens epithelial cells in vitro withstood relatively large increases in the calcium content of the experimental culture medium over the optimum for the control medium without showing any great differences in microscopic appearance, growth and activity. It was only when the medium contained such a large increase that precipitations of calcium compounds occurred that the medium became toxic to the cells. On the other hand, relatively slight reductions of the calcium content of the medium produced toxic reactions.

THE CALCIUM OF THE AQUEOUS AND VITREOUS

The calcium level has been estimated as 6.2 mg. per hundred cubic centimeters for the aqueous and 6.8 mg. for the vitreous. These values represent the diffusible calcium, as the nondiffusible calcium is held back by the ciliary membrane. The blood serum has normally an average of 10 mg. per hundred cubic centimeters. Hunter [8] found the proportions of the latter to be: ionized diffusible, 2 mg.; nonionized diffusible inorganic, 3.5 mg., and nonionized nondiffusible organic, 4.5 mg. per hundred cubic centimeters. It is difficult to make such an analysis, but if one accepts the figures it is evident that the calcium in the aqueous and vitreous represents the ionized and nonionized diffusible fractions of the calcium of the serum. This is the state in which calcium can be utilized by the cells, in which it can pass through an animal membrane, such as the ciliary epithelium or lens capsule, or through the walls of the individual cells.

REDUCTION OF CALCIUM CONTENT OF AQUEOUS, VITREOUS AND LENS

Evidently all of the calcium of the aqueous, vitreous and lens is important. In the serum, the organic nondiffusible calcium is bound and serves only as a buffer to help keep the hydrogen ion concentration of the blood in a balanced state. However, in the aqueous and vitreous there is none of this organic form, and the system of hydrogen ion balance p_H 7.6 is more easily disturbed by changes in the salt or element concentration and ratio. This may be the mode of deleterious action on the lens in tetany and the cause of tetany cataract. A reduction of the total blood calcium probably produces a relatively great reduction in the diffusible calcium which is so important to the lens. This upsets

8. Hunter, D.: Lancet **1**:897 (April 26); 947 (May 3) and 999 (May 10) 1930.

the acid-base equilibrium and causes changes in the labile lens protein. Hydrolysis with some evidence of hydration in the form of vacuoles, cloudy swelling of the fibers, etc., may occur as a result of the less alkaline condition. These thoughts are not held to apply in any way to the mode of formation of senile cataract.

The effect of reduction of the calcium content of the medium in which the lens epithelial cells are growing must come from the reduction in the diffusible portion, and more likely the ionized form, as it was this fraction that was diminished. Undoubtedly, the proportions of calcium are not the same in the culture medium as in the blood serum. The completed medium in each experiment was not analyzed to discover the exact proportions of the various fractions of calcium. This would be difficult and not entirely satisfactory. However, it is known that in the experimental cultures the diffusible ionized fraction was reduced. In tetany the changes in the lens undoubtedly come from the reduction of the diffusible fraction in the blood serum and aqueous and perhaps more especially from a reduction in the ionized fraction.

THE RELATION OF CALCIUM TO THE OTHER ELEMENTS IN THE LENS

In any colloidal system, the ratio or balance of the various elements and ions and their combinations and relations to each other is important. The importance of the relation of phosphorus to calcium, particularly in formation of bone, is well known. In the lens, Burge showed that there is a marked difference in the sodium, potassium and calcium percentages when one compares the normal with the cataractous lens. Burge found the potassium content of the normal lens to represent 38 per cent of the ash. In proportion to the sodium and calcium, which are present in the normal lens in extremely small amounts, potassium is an extremely important element in the inorganic make-up of the lens.

In the relative proportions of calcium and potassium the lens is not unlike the red blood corpuscle. In the normal state, the semipermeable capsule of the lens and the cell wall of the red blood corpuscle permit large amounts of potassium to enter and they exclude all but a small amount of calcium. In the altered state of the membrane in cataract, however, the proportions of the elements are greatly altered.

The ratio of calcium to potassium is different in different species and in different tissues of the same species. Murray[9] found that in cultivation of the tissues of *Planaria dorotocephala,* a worm 15 mm. in length, living chiefly in limestone regions, it was necessary to have twice as much calcium as potassium in the medium, and even ten times

9. Murray, M. R.: Physiol. Zool. **1**:137 (April) 1928.

as much produced no harmful effect. In the cultivation of mammalian tissues, however, the ratio of these elements in the plasma, embryo extract and in the diluent Tyrode, Locke, Locke-Lewis or Ringer solutions is quite different.

The ratio of calcium to potassium is less in the aqueous, vitreous and spinal fluid than it is in the blood serum. Apparently less of the calcium gets through the semipermeable membranes of the ciliary body and choroidal plexus. The way in which calcium is practically excluded by the cell wall of the red blood corpuscle and the lens capsule, while potassium is permitted to enter freely and is built up to a tremendous amount compared to calcium, furnishes a striking example of the selective

Calcium-Potassium Ratio in Various Tissues and Fluids

	Calcium	Potassium	Ratio
Blood serum	10.1 mg. per 100 cc.	20.1 (Duke-Elder)	1:1.99
Spinal fluid	6.3 mg. per 100 cc.	17.5 (Berencsy)‡	1:2.77
Aqueous	0.0062 Gm. per 100 cc. (Duke-Elder)*	0.0189 Gm. per 100 cc.	1:3.04
Vitreous (ox eyes)	7.9 mg. per 100 cc. (Cohen)†	24.9 mg. per 100 cc. (Cohen)	1:3.15
Tyrode's solution	7.2 mg. per 100 cc.	10.4 mg. per 100 cc.	1:1.44
Locke's solution	8.8 mg. per 100 cc.	21.9 mg. per 100 cc.	1:2.49
Ringer's solution	9.0 mg. per 100 cc.	21.9 mg. per 100 cc.	1:2.43
Blood corpuscles	Practically none	180 (Bodanzky)§	
Normal adult human lens	0.0516 Gm. per 100 Gm. of dry weight approx. 0.13 per cent of ash (Adams)	38.8 per cent of ash	1:298
Normal adult pig's lens	0.08 per cent of ash (Burge)	34.30 per cent of ash	1:427
Cataract (U. S. A.)	12.5 per cent of ash (Burge)	9.80 per cent of ash (Burge)	1.28:1
Cataract (India)	6.0 per cent of ash (Burge)	5.81 per cent of ash (Burge)	1.03:1

* Duke-Elder, W. S.: The Nature of The Intra-Ocular Fluids, Brit. J. Ophth., supplement 3, London, George Pulman & Sons, Ltd., 1927.

† Cohen, M., in Contributions to Ophthalmic Science, Menasha, Wis., George Banta Publishing Company, 1926, p. 216.

‡ Berencsy, G.: Klin. Wchnschr. **8**: 2438, 1929.

§ Bodanzky, M.: Introduction to Physiological Chemistry, New York, John Wiley & Sons, 1927.

action of semipermeable membranes, but makes one feel that the colloidal solutions on the interiors of these membranes have much to do with the selective action.

EFFECT OF CHANGE IN POTASSIUM AND CALCIUM CONTENT OF MEDIUM ON LENS EPITHELIAL CELLS IN VITRO

Increase in Potassium.—EXPERIMENT 136.—In this experimental medium, the calcium was kept at the same level as in the control, but the potassium was increased 1.05 mg. per hundred cubic centimeters above the level of the control. After four passages in seven days, there was no evidence of any difference between the experimental and the control cultures.

EXPERIMENT 114.—The calcium was at the same level as in the control medium. The potassium was increased 3.6 mg. per hundred cubic centimeters. The results were not entirely conclusive, as the controls were better on the whole, but the experimental cultures did not fare badly.

Increase of Both Calcium and Potassium.—EXPERIMENT 132.—The calcium content of the medium was increased 1.19 mg. and that of the potassium 4.8 mg. per hundred cubic centimeters over the control levels.

EXPERIMENT 122.—The calcium content of the medium was the same as in experiment 132, but the potassium content was further increased to 6.9 mg. per hundred cubic centimeters over the control levels.

The results of experiment 132 after eight days with four passages and of experiment 122 after five days with three passages indicated that the experimental medium, while not actually toxic, was not as good as the control medium for lens epithelial cells in vitro.

Decrease of Both Calcium and Potassium.—EXPERIMENT 120.—The calcium was reduced 1.19 mg., and the potassium 1.72 mg., per hundred cubic centimeters. The medium was not actually toxic, but the control cultures were better.

Comment.—Experiment 120 is to be compared with experiment 71, in which there was a similar reduction in the calcium but not in the potassium. The results indicated that the medium in experiment 71 was more toxic, although this conclusion cannot be drawn because there was some other factor injuring the control cultures in that experiment.

In the experiments reported in another section in which calcium was increased and potassium kept at the same level as the control cultures, there was no evidence that the relatively lesser amounts of potassium in the experimental cultures had any injurious effects on the cells.

In the other experiments in which the calcium was decreased while the potassium remained at the same level as the controls, there was relatively a greater percentage of potassium present in proportion to the calcium. In these experiments, the toxic effect of the medium was evident. It is possible that the disturbance of the calcium-potassium ratio had something to do with this effect.

It is recognized that these experiments are incomplete and that the data on which to base conclusions are meager. They are regarded only as the starting point for a complete investigation of the relation of the inorganic substances and their compounds in the aqueous, vitreous and lens.

The experiments in every instance showed clearly the sensitive reactions of the living cells as contrasted with chemical reactions in dead or dying tissue. It compelled one to realize that for logical conclusions, complicated controls must be set up. One ion or salt cannot be increased or decreased without directly affecting the balance or equilibrium of the solution and the ratio of the various elements which is so delicately adjusted in the vital process. The remarkable constancy of the calcium level of the blood serum in the same person is sufficient proof of the remarkable balance which is automatically adjusted.

SUMMARY AND CONCLUSIONS

Of all the tissues of the body the crystalline lens seems best adapted to valid experiments in vitro because of the peculiar conditions surrounding it in vivo. It does not depend on direct circulation of blood but on the aqueous humor for its metabolism. It should be possible to produce a true and complete synthetic aqueous humor and, simulating the other conditions, to cause the entire lens to live in vitro and to maintain its transparency.

Experiments were performed with living lens epithelial cells to show the effect of increasing and decreasing the calcium content of the experimental medium. The amount of calcium in the control medium was subject to variations, owing to the fluctuations in the calcium content of the chick embryo extract and of the chicken plasma.

It was found that epithelial cells of the lens in vitro will withstand relatively large increases in the calcium content of the experimental medium over the level for the control medium without showing any great differences in microscopic appearance, growth and activity. It was only when the medium contained such a large increase that precipitations of calcium compounds occurred that the medium became toxic to the cells. On the other hand, relatively slight reductions of the calcium content of the medium produced toxic reactions in the cells.

The fraction of the calcium that was reduced in the experimental medium was the ionized diffusible portion, as the calcium in Tyrode's solution is in that form. The normal aqueous humor probably contains only ionized and nonionized diffusible calcium.

The humors of the body and of the eye have a variable calcium content and the ratio of the calcium to the potassium content varies for different humors. Again, the humors differ tremendously from the cells and tissues. An interesting parallel was found between the calcium and potassium ratio of the red blood corpuscles and the crystalline lens as compared with that of the blood serum, aqueous, vitreous, spinal fluid and various fluids used in physiologic experiments. In cataract, the ratio is in part reversed.

The experiments bearing on the calcium-potassium ratio in vitro were too few in number for one to draw any definite conclusions. They open up interesting possibilities, however, for future work. The action of the semipermeable membrane of the crystalline lens in excluding all but a small amount of calcium and allowing potassium to enter and be built up to relatively tremendous proportions when compared with the amount of calcium is a remarkable phenomenon.

CALCIUM IN RELATION TO CATARACT

II. IN VIVO *

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Many empiric studies have been made with the hope of discovering something that would prevent the dreaded onset and progress of cataract or restore useful vision to those afflicted. It is a fact that in certain eyes there are observed opacities which have developed to a certain stage and then, because the factor that produced them has become inactive, no longer progress. The opacity is pushed toward the center of the lens as more clear cortex is formed by the equatorial cells. The observation time and again of this phenomenon, rather than the reports of spontaneous absorption or retardation, arrest or cure of cataracts by various local and systemic measures, constitutes a valid reason for continuing the study of the nonsurgical treatment for cataract, both from the clinical standpoint and by fundamental investigations into the nutrition and metabolism of the crystalline lens.

One avenue of approach to the subject has been through the study of the inorganic salt metabolism, as normal growth and senescence are fundamentally dependent on the normal or abnormal function of this mechanism. Inorganic elements play an important rôle in the make-up of the crystalline lens protein.

There has been known for some time the association of cataract with infantile and other forms of tetany and parathyroid deficiency, conditions in which it was definitely recognized that the calcium metabolism was disturbed. Several investigators have also considered senile cataract to be associated with latent tetany and parathyroid deficiency or with senile decrease in function of other endocrine glands.

So much has been learned recently concerning calcium metabolism that it seems worth while to revive interest in the subject and to pursue a complete study in regard to the relation of calcium to the eye and particularly to the lens and cataract.

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* The complete report on this subject, with clinical data and references, was published with the Transactions of the 1930 meeting of the American Academy of Ophthalmology and Oto-Laryngology of which the author is Research Fellow in Ophthalmology. The investigations were conducted in the Department of Ophthalmology, College of Physicians and Surgeons, Columbia University.

CONCENTRATIONS OF CALCIUM IN THE BODY

The calcium of the blood is almost entirely in the serum. The level of the blood serum is normally from about 9 to 11 mg. per hundred cubic centimeters. The calcium is combined in the blood with protein and various anions. About 54 per cent of it is diffusible; that is, it is in inorganic form and can pass through an animal membrane. This is the form which is found in the spinal fluid and in the aqueous and vitreous humors. Collip feels that it is impossible to say how much of the calcium in the blood is ionized and how much is nonionized, but more recently Hunter found the proportions to be: ionized diffusible, 2 mg.; nonionized diffusible inorganic, 3.5 mg., and nonionized non-diffusible organic, 4.5 mg. per hundred cubic centimeters. This fractionation is important, as it is only the diffusible calcium which gets into the aqueous, vitreous and lens.

Calcium in the Aqueous and Vitreous.—Duke-Elder found the average amount of calcium in the aqueous to be 6.2 mg., and that of the vitreous 6.8 mg., per hundred cubic centimeters of material obtained from horses' eyes. Cohen found an average of 7.4 mg. of calcium in the aqueous and 7.9 mg. in the vitreous of ox eyes. The extremely small amount of human aqueous and the element of risk attached to securing it has rendered data from this source meager and unreliable. It may be assumed, however, that the ratio holds true in the human eye, and that the aqueous and vitreous contain a little more than half (from 5 to 7 mg. per hundred cubic centimeters) of the amount of calcium found in the blood serum (from 9 to 11 mg. per hundred cubic centimeters). This is comparable to the amount contained in the spinal fluid. In many ways, in mode of formation and in composition, the aqueous resembles the spinal fluid.

Calcium in the Lens.—Burge found the calcium content of the normal lens too small to estimate. In the cataractous lens observed in the United States there was 12.5 per cent of calcium in the ash, while in the Indian cataracts there was 6 per cent. Adams figured that the former was equivalent to 0.21 per cent of the dry weight, while the latter was 0.09 per cent of the dry weight.

Adams found an average of 0.0516 Gm. of calcium per hundred grams of dry weight of the crystalline lens, while that of the human cataractous lenses was 0.1265 Gm. She found no definite age variation in the calcium content of normal or cataractous lenses. She confirmed Burge's results, but found a considerable variation in the calcium content of individual cataractous lenses, the deposition of calcium in cataract being therefore an erratic process. Frozen sections of cataractous lenses showed an irregular deposition of calcium in the individual lenses. One

in every ten or fifteen showed fairly large circular deposits of radiating crystals. These were described by Wessely and Kranz, who found them to be crystals of calcium phosphate and who thought that they represented a local deposit of calcium in areas where a colloid or protein degeneration had occurred. Adams used a number of staining reactions and confirmed the presence of calcium.

Calcification of the Lens.—Calcification of the lens may occur within the intact capsule, and is often found in the final stages of complicated cataract, in shrunken globes and sometimes in diabetic cataract. Partial calcification is also seen in old anterior capsular cataract.

CALCIUM DEFICIENCY AND ITS RELATION TO CATARACT

Tetany.—Zonular cataract is found chiefly in children who have suffered from convulsions (Arlt). At the same time peculiar changes are found in the teeth (Horner) which, together with the cataract itself, are regarded as due to tetany (Peters and others), although formerly both conditions were attributed to rickets. The lens, which in its development has much in common with the teeth, is also supposed to undergo some disorder during a period of its development, while later, after the disappearance of the disorder, normal transparent layers of lens substance are again deposited. Hess quoted Dick, who found hypoplasia of the dental enamel in a large percentage of cases of zonular cataract. In tetany, as a result of parathyroidectomy, calcium may be as low as from 2 to 3 mg. per hundred cubic centimeters of blood serum, while in latent tetany, demonstrable only by altered electrical reactions and by the Chvostek sign, the calcium content varies between 6 and 10 mg. When it is below 5 mg., convulsions occur. In rickets, however, in the absence of tetany the blood calcium is seldom lowered. There have been observed cases of marked rickets with a normal calcium content. Patients with rickets who have cataract also undoubtedly have had tetany. Cataract has been observed in endemic tetany, postoperative tetany, tetany complicating rickets and spontaneous hypoparathyroidism. In dogs, thyroparathyroidectomy may produce opacities in the lens within periods varying from three months to two years. Peters expressed the opinion that cataract following tetany is due to a shrinking of the nucleus brought about by interference with normal nutrition. His suggestion was that cramp of the ciliary muscle, which occurs in the course of the spasms, causes an irregularity in the flow of the lymph.

Infantile Tetany.—At the Babies Hospital, New York, thirty-three patients with tetany were treated during the past two years. The records of twenty-seven of these patients were available for this study;

eighteen were male, and nine female. They ranged in age from 2 weeks to 18 months. Twenty of the patients had antecedent rickets. The blood calcium ranged from 4.2 to 8.0 mg., with an average of 6.1 mg. per hundred cubic centimeters. Except for two of the infants, who died from intercurrent disease, the patients were uniformly improved by the measures taken to improve the calcium metabolism. In no case was cataract present or did it develop during the period of observation. There were no readmissions because of recurrence of the tetany. Undoubtedly, these conditions now prevail throughout the country. The better understanding of the nature of tetany, its prevention and cure has led to a great reduction in the number of tetany cataracts.

Incomplete Tetany Cataracts Seen in Later Years.—Zonular or lamellar cataracts are often seen when it is evident that the factor that caused the opacity has ceased to act. Clear cortex has been formed and has pushed the opacity toward the center of the lens. Two such cases were observed, one in a boy aged 9 years and the other in a man aged 37. In both of these, the serum calcium was normal and there was no evidence of latent tetany.

Postoperative Tetany with Cataract.—Reports of thirty-eight cases of postoperative tetany with cataract have been published to date. A review of Cole's case will be interesting:

> In a woman, aged 34, a goiter had developed at the age of 18. One year later, some glands were removed from the side of the neck. At 33 years, the goiter had grown so large that it had to be removed. A week after the operation, there was stiffness of the fingers and difficulty in the use of several other muscles. In July, 1928, she had a fit and lost consciousness for one hour. She then first complained of dim vision lasting for one hour. Two other fits were experienced in the same month and each was followed by dimness of vision. No more fits occurred for five months; then in December, 1928, she began to have several each day; they stopped in March, 1929. The misty vision did not pass off quickly after the fits in December and it gradually became continuous. The eyes showed fairly generalized cataracts, both cortical and nuclear, laid down in large pyramidal masses, with bases toward the periphery. From Cole's description and from the illustration, one can discern a diffuse clouding with split sutures forming the pyramidal masses described. A diet with a high calcium content and calcium lactate had a marked effect in increasing the serum calcium and controlling tetany, but did not bring the calcium to the normal level until combined with parathyroid extract-Collip.

It is worth while noting that Cole described a marked increase in the opacity of the lens following an increased calcium diet without parathyroid extract. In the first two weeks of treatment the cataracts went on to complete opacity in both eyes while the tetany disappeared. As a precaution, as Cole advised, it may be wise in severe parathyroid tetany to give parathyroid extract before administering calcium intravenously or before increasing the amount of calcium by mouth.

The prognosis for vision in such cases depends on the removal of the cataracts. There is no reason why this should not be successful. In Cole's case the operation had not been completed. Ruedemann removed postthyroidectomy cataracts with good results.

Cataract Complicating Postthyroidectomy Tetany.—Reeder published what appears to be still another case of cataract following thyroidectomy. It was evidently caused by the coincident removal of the parathyroid glands. In a woman, aged 40, the thyroid was removed six months from the time goiter with toxic symptoms developed. A few days after operation, tetanic spasms developed which were arrested by large doses of calcium lactate and parathyroid. These were given at intervals for over a year. Tetany practically disappeared six months after the thyroidectomy. Eighteen months later, she had a well advanced cortical cataract in each eye. Removal of the cataract from each eye gave good visual results.

Pathology of Tetany Cataract.—The work of Siegrist and Goldmann showed that the opacity in parathyroidectomized dogs is always subcapsular at first, and appears in close relationship with attacks of tetany.

The capsular epithelium shows degeneration. The form of the cell is changed, the cells appearing necrotic. The nucleus changes in form and staining. Here and there, however, a mitotic figure is observed. Disintegration is visible in the superficial fibers of the lens, empty spaces appearing between them filled with minute fat, protein droplets or homogeneous substance. Such changes are not found in the nucleus of the lens. The ciliary epithelium shows no pathologic changes.

Pathogenesis of Tetany Cataract.—The lowered serum calcium level in cases of tetany means that there is a proportional diminution of the calcium of the aqueous, vitreous and lens. While this total amount is extremely small, the electrochemical changes and the disturbance of equilibrium, depending on the loss of these calcium ions, are out of all proportion to the chemicals involved. This lowered serum calcium level can certainly cause changes in the labile lens protein; hydrolysis with some evidence of hydration in the form of globules, vacuoles and cloudy swelling of the fibers of the lens, occurring as a result of the change in hydrogen ion concentration.

This does not entirely explain the development of the cataracts, as the latter come on only after the convulsions and do not appear if the convulsions are controlled early. This points to either a qualitative or a quantitative change in the aqueous as a result of the convulsions.

Prevention of Postoperative Tetany and Cataract.—The prevention of removal of the parathyroids with thyroid tissues is important. It is best accomplished by leaving the posterior and mesial portions of

the lateral lobes. This precaution will usually preserve even the glands that are placed in anomalous positions. In a series of about 500 cases at the Presbyterian Hospital, Parsons had only 3 cases of considerable parathyroid deficiency and 3 cases of mild disturbance. All patients are watched carefully after thyroidectomy, and if they show the first premonitory symptom of circumoral constriction or difficulty with speech or with moving their lips—this symptom coming on before the Chvostek sign is positive and before they have any carpopedal spasm—they are given calcium lactate (up to 30 grains [1.94 Gm.] daily) and parathyroid extract-Collip (15 units daily). Only one patient failed to respond fully to this treatment, but severe tetany or cataract did not develop.

CALCIUM METABOLISM IN RELATION TO SENILE CATARACT

For this study only the progressive types of senile cataract were selected: 1. The nuclear variety is a pathologic form of nuclear sclerosis with hardening that may go on and involve the entire lens. The color of the lens usually changes from amber through shades of red to black. This color, as Burdon-Cooper showed, is due to hydrolysis of the lens protein with the formation of tyrosine, which when oxidized gives the color reactions. 2. The cortical variety begins in the senile cortex with vacuoles, water splitting of the sutures or lamellar separation, going through the familiar stages to maturity. 3. The posterior cortical saucer-shaped variety develops slowly and progressively. 4. A rarer form begins, usually in the younger group of elderly persons, with vacuoles and a thin layer of opacity just beneath the anterior and posterior capsules, rapidly going on to complete opacity through diffuse clouding and swelling of the entire lens.

The Mechanism of the Deposition of Calcium.—In order to understand the relation of the deposition of calcium to senile cataract, it is well to inquire in what form the calcium is deposited in senile cataract and whether this is a primary or a secondary process.

In normal formation of bone or in repair of fractures, Murray showed in his original investigations that the deposition of calcium may be dependent on a local concentration of calcium and on the action of ferments, of which a phosphatese has been identified as working best in an alkaline reaction more alkaline than the blood serum. Elsewhere in the body, death of tissue with replacement by granulation tissue will lead to formation of bone, if the hydrogen ion concentration is right and if there is a local supply of calcium available. An example of this undoubtedly is found in the abnormal formation of bone in the choroid. In the lens, it is not possible for connective tissue to replace the dead or dying lens tissue, and so the deposition of calcium is in some other form. Wessely and Kranz stated that the calcium

is combined with phosphate, but Adams found the tests for phosphate in cataract only weakly positive. In this connection, however, it may be said that the test for phosphate is not conclusive, even in bone. Only a small percentage of cataracts showed the deposition in the so-called spherolith form, which Wessely noted in his patients aged 70 or more. It may be assumed, therefore, that these spheroliths form only at a late stage and that in the other cataracts the calcium is more evenly distributed. There is a similarity in some ways, as Adams pointed out, between the deposition in cataract and in the intima of sclerosed blood vessels where the cholesterol is markedly increased. Adams could not, however, establish any intimate connection between the calcium and cholesterol in cataract such as is found in atheroma.

The presence of increased calcium in cataract is either (1) primary and an actual etiologic factor in producing opacity of the lens or (2) secondary to local changes in the tissue which exist in the lens regardless of the calcium content of the serum, aqueous or lens.

If it is primary, it is interesting to speculate on the possible mode of action in the production of the opacity: (*a*) It might act in reducing the permeability of the capsule. Friedenwald demonstrated that in vitro calcium has this action and he showed that under other conditions it takes only a relatively slight reduction in the permeability of the capsule to obstruct the metabolic processes of the lens sufficiently to cause cataract. (*b*) In sensitizing the lens protein for an abnormal action of ultraviolet light, Burge found that in vitro the lens protein could be so influenced by calcium that ultraviolet light would act to precipitate it, but he concluded that the concentration of calcium and the amount of light necessary to produce this in vitro are not found in vivo. (*c*) In altering the colloidal system of the lens, precipitation of the protein occurs. Here again Adams found that the conditions necessary for this reaction are not met with in the living body. Finally, it must be remembered that there is no direct evidence that the calcium of the lens is increased before cataract forms.

Deposition of Calcium a Secondary Reaction.—One must feel, therefore, that the increase of calcium in cataract is not primary, that it is not the cause of cataract, but that it is a coincident or secondary change which takes place with or follows other alterations in the lens. The deposition of calcium is probably a matter of changes in the hydrogen ion concentration and ferment activity of the lens following the production of some adsorption affinity for calcium resulting in a local concentration.

The hydrogen ion concentration and the ferment factors in the lens may be affected by the following conditions: (1) quantitative and qualitative changes in the aqueous deleteriously affecting the nutrition

and metabolism of the lens, and (2) death of lens tissue. These alterations in turn affect the factors in the local concentration of calcium, as certain by-products of abnormal metabolism or death of lens tissue resulting from faulty metabolism have an affinity for calcium. The particular substances are the phospholipoids. These, which represent about 1 per cent of the total dried substance of the normal crystalline lens, are perceptibly increased in the elderly person to about 2 per cent, while in cataract there is as much as 13 per cent. The same holds true for the fatty acids, always at a minimum in the normal state, but increased considerably in the presence of cataract. Between the element calcium, which is a bivalent cation carrying a double positive charge, and the large molecule of the lipoid, which has surface ions of the opposite charge, there is an adsorption affinity which would account for the attraction of the calcium to the altered lens. One cannot find the usual form of calcium phosphate in the lens. Adams' tests for phosphate were only weakly positive. The attraction of calcium to the lens cannot be explained on the basis of the calcium as an alkali being called on to counteract local acidity. If it performed this action, the combined molecule would probably go out through the lens capsule and be excreted. For the deposition of calcium, once the local concentration has been established, one needs an alkaline reaction, more alkaline than the normal p_H of the lens. Rapid death of tissue gives a change in the p_H toward the acid side. Murray has postulated that very slow death of tissue, on the other hand, gives a change toward the alkaline side. This is probably what occurs in the production of cataract: very slow death of tissue, degeneration of the lens protein with lipoid by-products, local concentration of calcium by adsorption to the large molecules of the lipoids, and deposition of this calcium by change in the p_H toward the alkaline side.

NO LATENT TETANY IN CASES OF SENILE CATARACT

In twenty-four patients with senile cataract examined carefully at the Vanderbilt Clinic, no symptoms or signs of tetany or latent tetany were demonstrable. In my entire experience with senile cataract, no case suggestive of tetany has been seen.

The Serum Calcium Level.—Tron, using de Waard's method, investigated the serum calcium of ten persons without cataract, aged from 42 to 59 years, and found an average level of 13.1 mg. per hundred cubic centimeters. In twenty-five cases of senile cataract, the average was 12.25 mg. Polichova found the average normal value to be 13.5 mg., while in fourteen cases of cataract it was 13.8 mg. These values are manifestly above what is now considered to be the normal level

according to the more modern and approved technic. Pellathy, using Kramer and Tisdall's method, found the normal values to range between 9.8 and 11.7 mg., while forty-eight cases of cataract showed between 9.1 and 12 mg.

Adams published the most recent report on the level of calcium in the blood of patients with senile cataract. She used an approved technic and estimated the blood serum calcium of normal and cataractous patients of similar ages. She found in the normal persons from 8.32 to 11.39 mg. (average, 9.76 mg.) per hundred cubic centimeters, and in those with cataract from 9.72 to 12.85 mg. (average, 11.46 mg.). She concluded, therefore, that in senile cataract the serum calcium is appreciably raised. These observations contradict the theory that senile cataract is associated with a low calcium content of the blood or with parathyroid insufficiency.

STUDY OF TWO SERIES OF CASES OF CATARACT

It is interesting to compare the results of an investigation of this subject in a series of cases at Bellevue Hospital and in another series at Vanderbilt Clinic. Different assistants and technicians were employed. It cannot be said that the type of patient varied sufficiently to be of note.

As far as possible, sources of error were eliminated. The Kramer and Tisdall method for determination of serum calcium was used in both series. The blood was usually taken in the afternoon when the patients visited the clinic.

Bellevue Series.—Twenty-eight men, aged from 52 to 80, fifteen with senile cortical, eleven with senile nuclear and two with combined nuclear and cortical cataract, had serum calcium levels ranging from 8.4 to 14.3 mg. (average, 11.3 mg.) per hundred cubic centimeters. Twenty-five women, aged from 52 to 82, fourteen with senile cortical, eight with nuclear, and one with cortico-nuclear cataract, and two with aphakia, had serum calcium ranging from 9.3 to 13.7 mg. (average, 10.9 mg.) per hundred cubic centimeters. There was no age difference or tendency to grouping according to the type of cataract. The value for the male group was 0.4 mg. higher than that for the female group.

It was thought at first that it would be better to reject this series because of the apparently more accurate results obtained later at the Vanderbilt Clinic. It is similar, however, to the series reported by Adams. If one were to select a smaller series from the fifty-three cases, one could prove that quite a high calcium content of the blood serum exists in cases of cataract.

Vanderbilt Clinic Series.—Control Cases: Eighteen patients without cataract in whom the serum calcium level had been estimated were

studied for purpose of comparison. There were fourteen men and four women, ranging in age from 32 to 67, with various ocular disorders. The serum calcium values ranged from 9.7 to 11.4 mg. (average, 10.6 mg.) per hundred cubic centimeters. This entire series cannot be regarded as normal cases, such as Adams used in her control series, but eight of the cases can be so looked on. The average for these eight cases is the same as that for the total group of eighteen and for the ten pathologic cases.

This series is small, but it need not be made larger, as the normal figures for all types and ages have been worked out by many observers as between 9 and 11 mg. per hundred cubic centimeters of blood serum.

Cases of Cataract: Thirty-three male and fifty female patients with cataract were studied as to their age, type of cataract, vision with correcting glasses and complicating factors in relation to the blood serum calcium level.

The male patients ranged in age from 25 to 82 years, and the female from 12 to 82. No relation between age and serum calcium level could be found. The average for the two sexes differed by only 0.05 mg. per hundred cubic centimeters: 10.29 mg. for the male and 10.34 mg. for the female patients.

The series was selected with the aid of the slit-lamp and microscope. A few cases of cataract in younger persons were included. A predominance of cortical cataracts was found (fifty-two), and in these cases the average serum calcium level was 10.36 mg. per hundred cubic centimeters. Nine cases of nuclear cataract gave an average of 10.22 mg. Eight cases of corticonuclear cataract were also found to have an average of 10.22 mg. Nine cases of posterocortical cataract gave an average of 10.01 mg.; three of lamellar cataract, 10.2 mg., and one each of equatorial wedge and coronary cataract, 10.7 and 10.5 mg., respectively. There was no relation between the calcium level and the visual quotient in any of the various types.

Diabetes was the most common complicating or etiologic factor found. Only those cases with sugar in the urine were noted in this series. It does not include the cases discoverable by the dextrose tolerance test. The average calcium level for twelve cases of diabetes was 10.58 mg.; for four cases of glaucoma, 10.27 mg.; for three cases of uveitis, 10.53 mg.; for four cases of otosclerosis, 9.67 mg., and for those with renal and vascular disease, 10.65 mg.

Manifestly, there is no significant relationship in the matter of the serum calcium level and the factors of age, sex, type of cataract, visual quotient and complicating or incidental disease. The average and the greater percentage of the cases are well within the normal limits.

There were only eight values above the upper limit of 11 mg. per hundred cubic centimeters, and only one below the lower limit of 9 mg. There were twenty-four between 9 and 10 mg., with an average of 9.7 mg.; forty-seven were between 10 and 11 mg., with an average of 10.46 mg. As far as can be judged from the serum calcium levels of these patients, there is no deficiency of calcium in cases of senile cataract. The tendency is toward the upper normal limits. Therefore, as judged by the serum calcium level, there is no deficiency of parathyroid secretion in elderly persons with cataract, but actually normal levels in the greater percentage of cases, with a tendency to a mild hypercalcemia in a few.

THE ENDOGENOUS CALCIUM METABOLISM OF PATIENTS WITH CATARACT

It was realized that the serum calcium level did not represent the flow of the element, either into the tissues or into the excreta, or the relation of calcium intake to output. In children and adolescents, the need for the development of bony structure requires a great disproportion between intake and output with a flow of calcium into, and storage in, the bony tissues. In adults and elderly persons there is need for a balance between intake and output. There is a normal metabolic exchange of calcium in their bony tissues and a storage in the fine bony trabeculae to meet emergencies when available base is called from the alkali reserve. As the patients with cataract had a normal serum calcium level, with a tendency to slightly higher normal limits in 66 per cent, it was desirable to know whether the latter had excess parathyroid secretion, excess acid production from dietary error or from tissue breakdown and whether they were storing or excreting the excess. If they were storing it, was it going into the normal storehouse, the bony trabeculae, or into tissues such as the lens? If it was entering the latter, could agents which favored excretion withdraw it from the lens and restore part of the transparency of the lens tissue?

The study of the relation of the intake and output of calcium in patients with cataract was first undertaken in patients who were being operated on for cataract. They were in the general eye ward at the Presbyterian Hospital. It was soon realized that conditions, while ideal from the surgical standpoint, did not offer full control over diet and the care of the specimens. The bowel movements were necessarily irregular while the patients were in bed after the removal of the cataracts, so that the estimation of the fecal content of calcium after catharsis did not give the proper relation between intake and output. The urinary output was more constant, but that alone does not give the proper basis for judgment of the situation. Sixteen patients were

examined under these conditions and necessarily no conclusions can be drawn from the data obtained. It was therefore with proper appreciation that the facilities of the male metabolism ward in Presbyterian Hospital were used when offered for the continuation of the study under controlled conditions.

STUDIES IN THE METABOLISM WARD

Six patients with senile cataract were selected for this study (tables 1 to 5). Complete histories were taken and physical examinations

TABLE 1.—*The Effect of an Approximately Neutral Diet on the Calcium Balance*

Case	Average Calcium Intake per Day	Average Calcium in Urine per Day	Average Calcium in Stool per Day	Average Total Calcium Excreted	Average Calcium Exchange per Day
1	631	207	430	637	— 6.0
3	637	178	451	629	+ 8.0
5	717	290	401	691	+26.0
6	524	149	288	437	+87.0

TABLE 2.—*The Effect of an Acid Residue in the Diet*

Case	Average Daily Intake of Calcium	Average Calcium in Urine	Average Calcium in Stool	Average Total Calcium	Average Calcium Exchange	Average Acid Residue
3	630	252	574	826	—196	18.7
4	655	249	462	711	— 56	3.7
5	608	410	411	821	—213	18.4
6	496	165	323	488	+ 8	5.5

TABLE 3.—*The Effect of Parathyroid Extract-Collip*

Case	Average Calcium Intake	Average Calcium in Urine	Average Calcium in Stool	Average Total Calcium	Average Calcium Exchange	Daily Units	Parathyroid Extract No. Days
1	615	187	591	778	—163	30	5

and blood, metabolic and functional tests performed before the patients were placed in the calcium metabolism ward. Here the intake and output in the excreta were carefully calculated. One must realize the laborious nature of such a study and that it can be carried out only through the intelligent and interested cooperation of dietitians, nurses, attendants and technicians. All the factors bearing on the calcium metabolism were controlled. The patients were weighed regularly. The amounts of carbohydrate, fat and protein in the diet were ordered and the total calories estimated. The fluid intake and output was measured. The acid and base residue equivalent of the diet was calculated

and for the preliminary tests was kept as near the neutral point as possible. Only male patients were selected because of the greater ease of obtaining the unmixed and complete specimens.

Analysis of Results.—1. Four patients with senile cataract were placed on a neutral or slightly alkaline residue diet and their endogenous calcium metabolism studied. Two were practically in perfect balance when the intake and excretion of calcium were compared. The other two were in positive balance, storing a small amount of calcium, most probably because of the slightly alkaline residue of their diet.

2. Four patients were placed on an acid residue diet. Two of the diets contained a small excess of acid and the other two contained considerably more acid. Three of the patients had been studied while on a neutral or slightly alkaline diet. The response to the acid diet

TABLE 4.—*The Effect of Parathyroid Extract-Collip Plus an Average Acid Residue of 18.5 Mg. Per Day*

Case	Average Calcium Intake	Average Calcium in Urine	Average Calcium in Stool	Average Total Calcium	Average Calcium Exchange	Daily Units	Parathyroid Extract No. Days
5	595	362	396	758	—163	50	5

TABLE 5.—*The Effect of Parathyroid Extract-Collip on the Excretion of Urine in Case 2*

Period	Average Calcium Intake	Average Calcium in Urine	Parathyroid Extract, Units
1 (5 days)	617	171	30 (last day)
2 (6 days)	674	216	50 (each day)
3 (3 days)	740	217	None

was typical. They excreted considerably more calcium than they did while on the neutral diet. In cases 3 and 6, the calcium was increased in both the urine and the stool, but more so in the former. In case 5, excretion was increased, chiefly in the urine. This is the typical effect of acid on the calcium metabolism. In case 6, the patient was still in positive balance, but to a much less degree than when on a neutral diet. In cases 3 and 5, the acid residue was greater than in cases 4 and 6, and the excess excretion of calcium was correspondingly greater.

3. The administration of parathyroid extract-Collip produced an increased excretion of calcium. However, in case 1, this effect was not typical as it was an increase of the calcium in the stool and not in the urine. It is interesting to note that the patient in case 5, while kept on an acid residue diet equivalent to that of a previous test period, did not excrete additional calcium in response to the administration of parathyroid extract beyond that called forth by the acid residue diet.

In case 2, the calcium excretion in the urine was increased by parathyroid extract.

Comment.—The important issues to be considered are those which are practical from a clinical standpoint.

1. Do these patients with senile cataract have any need of calcium therapy? As far as can be judged from this small series of cases investigated thoroughly, one can say that there is no calcium deficiency in these patients and that they do not require administration of calcium beyond that which can be obtained in a normal diet. Their diet should be neutral or slightly alkaline in residue to keep them in calcium balance and to avoid excess drain on the calcium reserves. It is far wiser to correct the diet, if need be, than to allow the patient to continue on an acid residue diet and administer calcium salts to make up for the excessive excretion of calcium. There was no evidence of an excessive endogenous production of acid in these patients.

2. Do the patients with senile cataract need parathyroid extract? Here the answer must be in the negative. The best regimen for elderly patients is one which keeps them in calcium balance or near there as they vary each day. The cases investigated were near the balance point when on a neutral or slightly alkaline diet. There is no need for parathyroid extract, as the excess calcium excreted comes out of the bones and not out of the cataracts. There is no need for raising the serum calcium with parathyroid, as it is high enough in the greater percentage of cases.

3. Are these patients utilizing their calcium properly? The answer is positive, for they show typical responses to neutral, alkaline and acid residue diets and to parathyroid extract.

SUMMARY AND CONCLUSIONS

The study of the relation of calcium to cataract was undertaken to clarify the situation in regard to this subject. It was desired: (1) to assemble the latest information regarding calcium metabolism in general, (2) to know the importance of calcium in the normal growth and metabolism of the crystalline lens, (3) to learn the cause and prevention of tetany cataract in both infants and adults, (4) to find the reason for the deposition of calcium in senile cataract, (5) to discover whether patients with senile cataract suffered from calcium deficiency or excess and (6) to know whether the administration of calcium or parathyroid extract was indicated in cases of senile cataract.

The calcium in the aqueous represents the ionized and nonionized diffusible fraction from the total calcium of the blood plasma. There is an extremely small amount present normally in the crystalline lens,

but the importance of the element in combination with the other elements is out of all proportion to the chemicals involved. Calcium is greatly increased in the lens in senile cataract.

Calcium deficiency in cases of infantile tetany is undoubtedly responsible for the development of cataract in these cases. Even though the factors that produce and cure rickets are the same as those for tetany, there is some difference that has not as yet been discovered between rickets and tetany, and cataract is linked up with the tetany rather than with the rickets complex.

No cases of tetany cataract have been seen at the Babies Hospital in the past two years. The widespread knowledge and use of the factors preventing and controlling rickets and tetany have led to a decrease in the number of tetany cataracts.

One illustrative case of postoperative tetany with cataracts from the thirty-eight cases to be found in the literature is reviewed. The important points to be learned are: (1) prevention of the removal of parathyroid tissue at the time of thyroidectomy, (2) early treatment of such patients as show parathyroid deficiency. A great many of the latter cases are undoubtedly only temporary, due to vascular disturbances.

The pathogenesis of tetany cataract implies a reduction in the serum, aqueous and lens calcium content with electrochemical changes and disturbance of equilibrium of the inorganic elements in the lens causing changes in the labile colloidal solution of the lens protein. Once these changes are established, the administration of calcium or parathyroid extract does not cause a restoration of the normal state of the protein. Not all tetany cataracts progress to complete opacity. The prognosis in complete tetany cataract depends on the operative removal of the cataract.

In cases of senile cataract, the deposition of calcium most probably results from (1) very slow death of lens tissue, dependent on nutritional deficiency; (2) degeneration of the lens protein with lipoid by-products; (3) local concentration of calcium by adsorption to the large molecules of the lipoids, and (4) deposition of this calcium by a change in the p_H toward the alkaline side.

There was no evidence of tetany or latent tetany in a series of cases of senile cataract.

Two separate series of cases of senile cataract were investigated as to the serum calcium level. In the first series twenty-eight men, aged from 52 to 80, had an average level of 11.3 mg. per hundred cubic centimeters, while twenty-five women, aged from 52 to 82, had an average level of 10.9 mg.

The second series included thirty-three men, from 45 to 82 years of age, whose average serum calcium level was 10.29 mg., and fifty women, aged from 50 to 82, whose level was 10.34 mg. No variation could be found according to age, sex, type of cataract, visual quotient or complicating ocular or general disease.

There is therefore no evidence of calcium deficiency as far as the blood serum values are concerned in cases of senile cataract.

In the study of the endogenous calcium metabolism in cases of senile cataract, the relation of the intake of calcium in the diet was carefully calculated and compared with the output of calcium in the urine and feces. The results showed that the patients were in perfect or slightly positive balance when on a neutral or slightly alkaline diet, but when on an acid residue diet or when receiving injections of parathyroid extract, they were in negative balance, excreting more calcium than they ingested. In other words, these patients were responding normally to the factors influencing calcium metabolism and were utilizing their calcium properly.

There was no indication for the administration of calcium salts to any of these patients. If patients with senile cataract are found to have normal serum calcium but are in negative calcium balance, it is better to correct the factor that is producing the latter than to administer calcium salts to them to make up the deficiency.

There was no reason for the administration of parathyroid extract to these patients, as they had sufficient serum calcium. Parathyroid extract-Collip produced excess urinary excretion of calcium, but the excess calcium that was mobilized from the tissues undoubtedly came from the normal storehouse, the bony trabeculae, where it is easily available, and not from deposits in the cataracts.

CONGENITAL ANOPHTHALMOS WITH ORBITOPALPEBRAL CYST *

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Many cases of anophthalmos, both unilateral and bilateral, have been described in the literature; nevertheless, the condition is rare enough to justify the report of another case.

In studying the embryology of the eye, one finds that it develops from a pouch of the first cerebral vesicle. This pouch consists of the mesoderm covered by ectoderm. This ectoderm invaginates and is cut off by the mesoderm, and the portion of ectoderm forms the lens. In maldeveloped eyes, as the margins of the ocular vesicles grow up against the process of the mesoderm, they find an obstacle, for some reason not well known, and, instead of closing the fetal cleft, they undergo rotation and grow in a faulty direction, forming a cystlike sac. The sac usually contains retinal tissue, while the eyeball remains rudimentary. Thus microphthalmos, and even anophthalmos, develops simultaneously with the cyst. The cyst is usually felt through the lower lid and may be very large.

In her book on the development of the human eye, Ida Mann [1] said:

> What congenital abnormalities might result if growth were interfered with at or before the 7.5 mm. stage?
>
> In the first place there might be a total failure of one or both primary vesicles to bud out from the forebrain; this would result in a condition of true anophthalmia, no trace of the ectodermal structures of the eye being formed at all though there might be differentiation of mesoderm. This abnormality, though known to occur, is extremely rare, since an aberration of growth gross enough to produce complete suppression of the front of the forebrain occurring at this early stage is liable to end in the production of an embryo too abnormal to survive at all. Clinically the condition is almost impossible to distinguish from severe degrees of microphthalmia, in which the eye can only be demonstrated by removal and sectioning of the contents of the orbit. Secondly if the primary optic vesicle failed to invaginate successfully, its cavity might undergo cystic dilatation and the condition known as *congenitally cystic eye-ball* would result. In this condition the orbit contains instead of an eye a large cyst in the walls of which are traces of nervous elements, the tissue in the anterior part of the cyst resembling retina, that posteriorly being pigmented. Here the arrest of development has occurred very early and very imperfect differentiation of neural ectoderm has taken place, and the cavity of the cyst is the cavity of the primary optic vesicle.

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* Submitted for publication, Dec. 18, 1930.

1. Mann, Ida: The Development of the Human Eye, London, Cambridge University Press, 1928.

If, however, the arrest of development occurred a little later after invagination of the primary vesicle but before closure of the foetal fissure, then a lens vesicle would have been formed and a certain amount of differentiation of the walls of the optic cup would be present but the eye would be very small (microphthalmia) and the cleft would be open (coloboma of the retina and choroid).

In such microphthalmic eyes there is apparently often a tendency for irregular overgrowth of the layers of the optic cup in the region of the open fissure, so that the cysts are formed behind and below the eye. Some of the cysts are lined with partial differentiated retina and pigment epithelium and their cavities are in communication with the cavity of the optic cup. They must be carefully distinguished from the cysts of the congenitally cystic eye described above in which the cyst is the cavity of the primary optic vesicle and no microphthalmic eye is present. Cyst in connection with microphthalmic eyes may also be found by dilatation of a localized portion of the cavity of the primary optic vesicle in the fissural region. In this case they are lined by a single layer of poorly differentiated neural ectoderm.

Seiler [2] quoted a case of Rudolphi's [3] in which autopsy was performed after birth, and in which no sign of a globe was found. There was also an absence of the third, fourth and sixth nerves and of the right optic nerve, which was represented by a stump, while the chiasm was present. As far back as 1609, there are descriptions of cases of anophthalmos. Seiler was of the opinion that it is due to intra-uterine inflammation. In cases of complete anophthalmos, other organs may be abnormally developed, such as the nose, the mouth and the arms.

Absence of the globe is usually associated with maldevelopment of the frontal lobes of the brain and a lack of all the contents of the globe, as well as defects of the skull.

Mayer [4] described a case in which the lacrimal canal and duct were absent. In some cases anophthalmos is also associated with coloboma of the lids and nevi.

On palpation of the lids in vivo, cystic masses may be felt, and while it cannot be stated positively that they contain uveal tissue unless a microscopic examination is made of the orbital contents, from the anatomic specimens described in the literature one may assume the condition to exist. Bock [5] expressed the belief that these cases are due to an intra-uterine panophthalmitis which existed in the early period of intra-uterine life, with the destruction of the lens and vitreous and a shrinking of the cornea.

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2. Seiler, D. B. W.: Beobachtungen ursprünglicher Bildungsfehler und quenzlichen Mangels der Augen, Dresden, 1833.

3. Rudolphi: Bemerkungen aus den Gebiete der Naturgeschichte, Medizin und Thierarztheilkunde, Berlin, 1804, vol. 11, p. 51.

4. Mayer, Max: Mikrophthalmus mit Cysten inz unteren Augenlid, Würzburg, A. Boegler, 1888.

5. Bock, Emil; and Wedl, Carl: Pathologische Anatomie des Auges, Vienna, 1886.

Failure of development of ocular vesicles may be ascribed both to internal and to external causes. The internal causes are due to heredity, the external, to intra-uterine inflammations. The earlier the disturbances, the more marked is the defect. In hereditary influences one must differentiate between inherent defects of the cells and diseases that are transmitted from the mother to the fetus. Disturbances of nutrition may also be a cause.

Only the cases in which the parents, brothers or sisters show the same abnormality can be called congenital. In other cases the absence of the eye may be ascribed to the pathologic destruction of the fetal eye by micro-organisms. It is not necessary to have direct bacterial infection; diffusion of chemical substances may act in the same way. Abnormal conditions of the amnion, in which adhesions subsequently result, may also be a cause.

Van Duyse [6] ascribed many defects to diseases of the amnion, such as polycoria, aniridia, coloboma of the iris and corectopia.

Abnormal development of the eye must be considered as originating from an abnormal development of the brain, as the eye is an outgrowth and a part of it.

Kundrat [7] stated that in microphthalmia there is usually also microcephalus. True anophthalmos exists only when there is no cyst. Von Hippel [8] stated that he collected sixty-three bilateral and twenty-three unilateral cases of anophthalmos. Many cases have a history of a purulent discharge from the conjunctiva at birth.

Von Arlt [9] expressed the opinion that the formation of cysts is due to the failure of the closure of the fetal cleft. Putcher described a case in which the cyst was in the upper lid.

REPORT OF A CASE

Sara La C. came to the New York Eye and Ear Infirmary to Dr. Key's service in September, 1930. The father and mother were first cousins. There was no history of a defect in the father's or mother's family. The patient was the first of two children. The other child was normal, with the exception of having convergent strabismus. At the age of 9 months, the mother took the patient to Bellevue Hospital to see if anything could be done for her. On looking up the history at Bellevue Hospital, I found that she was admitted on Feb. 3, 1922 and was discharged on February 11. The history at that time stated that there was no

6. Van Duyse: Persistance du canal de Cloquet, Arch. d'opht. **11**:404, 1891.

7. Kundrat: Ueber die angeborenen Cysten im unteren Augenlide: Mikrophthalmie und Anophthalmie, Wien. med. Bl. **8**:1557, 1885.

8. von Hippel, E.: Arch. f. Ophth. **47**:227, 1898.

9. von Arlt: Die Entwicklung der Mikrophthalmus und Anophthalmus congenitus, Anz. d. k. k. Gesellsch. d. Aerzte in Wien, 1884-1885, p. 100.

Fig. 1.—Appearance of patient with congenital anophthalmos.

Fig. 2.—The right optic foramen, normal in size but slightly irregular.

Fig. 3.—The left optic foramen, normal in size but slightly irregular.

Fig. 4.—The skull, showing the orbits undersized for the age of the patient; the sella turcica is of a normal, infantile type.

illness during or since birth. Birth was normal. She was born with rudiments of orbits. On examination, the lacrimal apparatus was found to be normal. The tension was decreased, and the diagnosis of cryptic globes was made. Beneath both lower lids, inferiorly, there were soft masses about 12 mm. wide on the right and 9 mm. on the left.

On the date of my examination, I found the eyelids small and undeveloped. The palpebral fissures were narrow; they measured 1.5 by 0.75 cm. The depth of both sockets was 2 cm. The puncti were present and patent. The lids could be opened and closed voluntarily. At the apex of the cone on the right side, a bluish speck could be seen. No bluish speck was visible on the left side. (There was no evidence of globes.) On palpation of both lower lids, small cysts could be felt.

The Wassermann reaction of the patient and that of the mother were negative.

Roentgen examination, made by Dr. Dixon, showed: "That aside from the orbits apparently being undersize nothing of importance was found about the skull or sinuses. The sella turcica was practically of normal infantile type. The optic foramina were visible but irregular. The orbits were smaller than normally

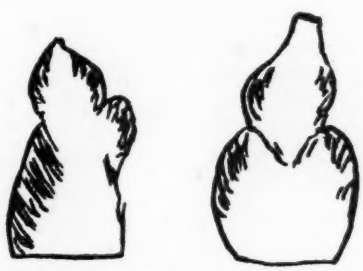

Fig. 5.—Wax model inpressions of the sockets of the eyes. The figure on the right is the socket of the right eye; the one on the left, that of the left eye.

for this age." This case was therefore one of bilateral anophthalmos with the formation of cysts, and I believe that it was probably due to a hereditary tendency, as the parents were related.

SUMMARY

Anophthalmos may be total or accompanied by the formation of cysts. The etiology may be endogenous or exogenous; the endogenous factors are due to heredity, and the exogenous, to toxemia or an intra-uterine infection.

Dr. William Doherty and Dr. Dixon assisted in preparing the case, and Dr. Isidore Goldstein corrected the manuscript.

RETINOBLASTOMA

ITS RECOGNITION WHEN THE FUNDUS OCULI IS OBSCURED*

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The earlier stages of retinoblastoma, when the process is situated in the vitreous, are well known and easily recognized. When the fundus has become obscured, however, diagnosis may be difficult, as is illustrated in the following case.

REPORT OF A CASE

A boy, aged 4 years, fell against a chair, striking his left eye on a rung. The eye was red for a while and then began to shrink. When first seen, eight months later, the globe was small, red and somewhat firm. The outstanding feature was the appearance of the cornea. This was perfectly opaque, and presented the grayish-brown coloration characteristic of blood-staining. Except for a small staphyloma below, no further details could be made out.

In this case, the history, the blood-stained cornea and the shrinkage of the globe seemed to indicate the presence of traumatic iridocyclitis. On enucleation, however, the eye was found to contain a retinoblastoma.

Four months later a recurrence took place in the orbit. Exenteration was performed, but the tumor was found to have passed backward through the optic foramen. Symptoms of intracranial pressure soon appeared, and the patient died in convulsions six months after operation.

When the fundus oculi has been obscured, certain signs in the anterior segment of the eye may suggest the presence of retinoblastoma.

The tumor may involve the iris. When this occurs, one usually finds small, white, rounded, slightly vascularized nodules on the anterior surface. Occasionally the tumor spreads in a thin layer over the stroma, or it may replace the tissue of the iris wholly or in part.

Sometimes the cells collect in the bottom of the anterior chamber, producing the appearance of hypopyon. When accompanied by a yellow reflex from the pupil, this has led to a diagnosis of panophthalmitis.

In its later stages, retinoblastoma may produce glaucoma. The eye is then enlarged and the anterior chamber deep, as in buphthalmos of the usual type. The glaucoma may become acute. Small staphylomas, most often intercalary, may occur, and these may form neoplastic nodules on the sclera.

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Sometimes the cornea necroses, and in time the bleeding tumor mass, extruding between the lids, produces the distressing condition known as "fungating exophthalmos." If the intra-ocular growth necroses, the globe may shrink.

Bleeding varies in amount and is revealed in a variety of ways. There may be discrete hemorrhages on the iris, varying degrees of hyphemia or, as in the case reported, dense blood-staining of the cornea. Morax reported a case in which recurrent hemorrhages into the aqueous and vitreous chambers obscured the fundus completely. The condition was believed to be tuberculous in origin; this was held to have been confirmed by the appearance of preauricular and cervical glandular enlargement on the affected side. At autopsy, however, the eye was found to contain a retinoblastoma which had extended to the adjacent lymph glands.

It is worthy of note that involvement of the lens does not occur until retinoblastoma has become far advanced. This delay is quite constant, and should be considered a characteristic feature of the disease.

SUMMARY

When the fundus has become obscured, the later stages of retinoblastoma may be recognized by certain changes in the anterior segment of the eye: (1) invasion of the iris; (2) pseudohypopyon; (3) glaucoma; buphthalmos; (4) shrinkage of the globe, with or without perforation, or (5) intra-ocular hemorrhage, with or without blood-staining of the cornea.

The appearance of any of these in a child whose fundus cannot be seen suggests the presence of retinoblastoma.

BIBLIOGRAPHY

1. Aubineau and Opin: Gliome rétinien à forme iridocyclitique avec envahissement précoce du corps ciliaire et de l'iris et buphtalmie, Arch. d'opht. **39**:240, 1922.

2. Bergmeister, R.: Berstung der Membran descemetii infolge von Drucksteigerung bei Gliom, Sitzungsb. d'ophth. Gesellsch., Wien **3**:16, 1914.

3. von Hippel, E.: Ist das Zusammenvorkommen von Mikrophthalmus congenitus und Glioma retinae im gleichen Auge sicher erwiesen? Arch. f. Ophth. **61**:351, 1905.

4. Jessop, W. H. H.: Glioma of Retina Simulating Hypopyon, Ophth. Rev. **20**:15, 1903.

5. Knapp, A.: Autopsy Report of a Case of Bilateral Glioma Retinae with Gliomatous Involvement of the Iris, Arch. Ophth. **53**:470 (Sept.) 1924.

6. Knieper, C.: Ein Fall von doppelseitigem Glioma retinae mit Enukleation des einen und nunmehr fast 11 jähriger Atrophie des anderen Auges, Arch. f. Ophth. **77**:330, 1911.

7. Lindenfeld, B.: Ueber "Spontanheilung" bei Glioma retinae, Arch. f. Ophth. **86**:141, 1913.

8. Meller, J.: Regressive Veränderungen im Netzhautgliom, Centralbl. f. prakt. Augenh. **39**:101, 1915.

9. Morax, V.: Cancer de l'appareil visuel, Paris, Gaston Doin, 1926, p. 323.

10. Neese, E.: Zwei Fälle von intraokularem Tumor im phthisischen Augen, Klin. Monatsbl. f. Augenh. **44**:460, 1906.

11. O'Connor, D. F.: Glioma Retinae and Atrophia Bulbi, Arch. Ophth. **46**: 298 (July) 1917.

12. Parsons, J. H.: A Case of Glioma Retinae in a Shrunken Globe, Ophth. Hosp. Rep. **16**:141, 1905.

13. Rados, A.: Regressive Veränderungen im Netzhautgliom, Bericht. ophth. Gesellsch. **41**:327, 1918.

14. Seidel, E.: Ueber die Ausbreitung des Glioms, insbesondere des endophytischen Typus desselben, Klin. Monatsbl. f. Augenh. **38**:399, 1900.

FOCAL INFECTION

AN ETIOLOGIC FACTOR IN DISEASES OF THE EYE*

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Since my arrival in America, about nine years ago, I have been impressed with the extent to which focal infection, as the cause of many varied diseases, has become an obsession to the medical profession in this country. The removal of tonsils, teeth, appendixes and gallbladders, all kinds of nasal operations, operations on sinuses and pelvic organs, etc., in order to cure all kinds of human troubles have become a rule. The prevalent opinion that these operations are necessary has influenced the medical profession to such an extent that a physician who would not advise some kind of surgical procedure could be afraid of being accused of lagging behind the modern progress of science and could be sure that some other colleague with "better knowledge" would advise it and thus put the timid physician in a precarious position.

I deem it proper for a physician who has been in practice thirty-four years and has had a considerable experience to say a few words against these exaggerations which are not based on scientific proof and which are often harmful and sometimes dangerous to the patients. I am interested in the practical application of the "focal infection theory" in relation to the eye and will touch on the theory itself so far as it is necessary for my purposes.

It is true that a systemic disease can be the result of a focal infection. Antisepsis and asepsis are based on this assumption. But what Billings, Rosenow and others tried to prove is that any focal infection, whether acute or chronic, may become and usually does become the cause of numberless diseases that afflict the human body. In this respect they emphasized the importance of tonsils, teeth, sinuses, appendixes, lymph nodes, gallbladders, prostate, etc., as the cause of many systemic diseases or secondary infections in distant organs. This theory has been generally accepted in this country as though there were no flaws in it. In order to cure all kinds of diseases the physician began to look for some focal infection which had to be eliminated. This trend of mind led to unnecessary operations against which Billings himself, the man who made the theory popular, warned the physicians.

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IS THERE A SCIENTIFIC BASIS FOR USING INDISCRIMINATE SURGICAL MEASURES IN SYSTEMIC DISEASES?

It is doubtful that there has ever lived a human being without a focus of infection. But large numbers of them live to old age without serious trouble. It means that the constant absorption of bacteria or toxins in these quite numerous cases has no effect whatever.

In order to explain a disease on the basis of the theory of focal infection one has to assume that the resistance of the body is to be taken into account. If the invasion of the bacteria or toxins meets with great power of resistance (immunity), there may exist a local focus without disturbing the body as a whole. One must also assume that bacteria are developing special pathogenicity under certain unknown conditions. If these conditions are absent, the focus will not be harmful. It is well known that the elimination of focal infection is successful only in some cases; that in the majority of cases the disease for which the elimination of the focus has been undertaken does not respond to this treatment. In order to explain these discrepancies on the basis of the theory of focal infection one has to assume that the wrong focus was removed, that there must be some other focus or foci, manifest or latent, which were not removed. In order to explain different diseases in different tissues, credited to the same local focus, mostly to the teeth and tonsils, it was necessary to prove that the bacteria have an elective affinity for different tissues, that they possess the quality of transmutation, that the bacteria which are saprophytic or slightly pathogenic may become very pathogenic and produce different diseases.

Rosenow [1] and others have tried to give experimental proof for these assumptions which has been taken as conclusive by Billings [2] in his lectures on focal infection. Rosenow's experimental work became the foundation of the whole structure.

Wilmer [3] in his latest article stated:

> The work done by Rosenow and also by Haden on the elective localization of bacteria from infected teeth is interesting and deserves further investigation, for some observers (Back) have not been able to obtain similar results. . . . The laboratory proof of pathogenic micro-organisms in the affected eyes suffering from dental sepsis has not been found.

Another enthusiastic supporter of the theory (Bahn [4]) made the following statement:

> Unfortunately there have been no recent epoch making advances in this field which can be compared with those of Billings, Rosenow and others. Many of our

1. Rosenow, quoted by Billings (footnote 2).
2. Billings, Frank: Focal Infection, New York, D. Appleton & Company, 1916, p. 128.
3. Wilmer, W. H.: The Relation of Teeth to Diseases of the Eye, Arch. Ophth. **4**:466 (Oct.) 1930.
4. Bahn, C. A.: Recent Advances Concerning Ocular Focal Infection, Texas State J. Med. **25**:412 (Oct.) 1929.

conceptions concerning focal infection are still speculative and have not been proven under the microscope. One must not forget, however, that from speculation of to-day comes the knowledge of to-morrow.

What is important, judging from foregoing quotations, is the fact that Rosenow's experimental proof of the theory, which has been accepted by Billings as conclusive, has been challenged by other observers. On the strength of Wilmer's and Bahn's testimony, it would be fair to say that the experimental studies of the theory of focal infection have not solved the problem yet.

For a practicing oculist it is difficult to argue against the theory. If there is an improvement in the ocular disease after the elimination of the focus, it is taken as a positive proof of the theory, though one knows that "post hoc" does not mean "propter hoc"; if the result is negative, as frequently occurs, it does not disprove the theory because there may be many foci, and one cannot eliminate all of them.

The theory creates a vicious circle. Billings [2] himself is against unnecessary operations. In his lectures on focal infection he said:

I do not wish to seem to be an advocate of unnecessary operations, for many operations of all kinds are irrationally performed including the removal of overgrowth of the tonsils and other lymphoid and mucous tissues of the nose and throat. These conditions of the nose and throat may disappear with proper hygienic management. I believe that tonsillectomy is often needlessly performed for a relief of a systemic infection, when the real cause is situated elsewhere. Doubtless the normal faucial tonsillar tissue has a beneficent function and uninfected should not be molested.

Billings is cautious. He advises to make sure that the teeth are infected before removing them. He insists on taking an x-ray picture. In some cases the teeth may be infected, but this can be revealed only by a roentgenogram.

But what is the criterion for determining that the tonsils or the teeth are not infected? Some specialists claim that the tonsils may look healthy and still be infected. In cases of rheumatic fever or other systemic diseases, they insist on removing the tonsils no matter how they look.

Rice [5] said:

Thousands of teeth that are symptom-free and that are roentgenographically negative are being examined in the bacteriologic laboratory after extraction and found to be infected.

What inference can be made from these assertions? That wholesale removal of the teeth and tonsils should be performed in each case in which one can assume with some probability that they may be the cause of the disease.

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5. Rice, E. C.: Focal Infection from Dental Standpoint, Ann. Otol., Rhin. & Laryng. **36**:285 (March) 1927.

Gay,[6] in a recent article on the treatment of ocular tuberculosis with tuberculin said:

> The use of tuberculin should never be considered in the treatment of a patient with a diseased eye unless all foci of infection have been removed.

One should be consistent. If beneficial results are not obtained by elimination of a focus, why not perform a vivisection in order to eliminate all the foci that may be latent? It should not seem too absurd. Recently at a medical meeting in Boston, Dr. Berg of the Mount Sinai Hospital of New York reported a case of duodenal ulcer for which the patient underwent fourteen major operations.

Moreover, to prevent is better than to fight disease! Why not remove the tonsils, appendix and gallbladder when the child is born and the teeth as soon as they appear?

If one accepts the theory of focal infection, one must come to these logical conclusions. But I doubt very much whether many of the supporters of the theory would accept these conclusions.

On the other hand, Haden[7] wrote:

> One patient had had a number of teeth removed for pain in the back. No relief was obtained since the symptoms were due to a stone in the kidney. Another patient had all his teeth extracted for weakness. Again no relief followed since the symptoms were due to an unrecognized pernicious anemia. . . . The ever present possibility that symptoms commonly ascribed to focal infection may be due to different causes.

Cushing and Eisenhardt[8] published several cases of meningiomas that were pressing on the chiasm and causing failure of vision. I read in the histories that in one case, after a submucous resection of the septum, the left ethmoid cells were completely exenterated and the sphenoid cells opened. Temporary relief followed. Then nine teeth were extracted, also with supposed temporary improvement in vision. After this improvement the patient came under Cushing's care, and a tumor was removed. In the other case a physician advised removal of the gallbladder, but the patient refused to follow the physician's advice. Cushing removed a tumor. I could continue similar cases ad infinitum.

Scleritis and keratitis are often attributed to infected teeth, but Verhoeff[9] expressed the belief that all cases of ordinary scleritis and keratitis (anterior nodular scleritis) are always due to tuberculosis.

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6. Gay, L. N.: The Treatment of Ocular Tuberculosis with Tuberculin, Arch. Ophth. **3**:259 (March) 1930.

7. Haden, R. L.: Etiology of Focal Infection, Ann. Otol., Rhin. & Laryng. **36**:896, 1927.

8. Cushing, Harvey; and Eisenhardt, L.: Meningiomas Arising from the Tuberculum Sellae, Arch. Ophth. **1**:173 and 178 (Feb.) 1929.

9. Verhoeff, F. H., in discussion on Benedict, W. L.; von Lackum, W. H., and Nickel, A. A. C.: Pelvic Organs as Foci of Infection in Inflammatory Diseases of the Eye, Tr. Am. Ophth. Soc. **24**:145, 1926.

There is nothing definite to uphold one's belief in the theory. What impresses me is that the articles of the expounders of this theory are abundant with the words seemingly, probably, possibly, apparently, etc.

MacCallan [10] attributed cataracts to diseased teeth. Wilmer said: "I have often felt that the teeth were a factor, but I have never been able to prove this." When I read a statement of this kind, I feel that the wish is often the father of the thought.

COMMENT ON WILMER'S CASES

Wilmer [3] presented three cases of his own to illustrate the connection between the ocular diseases and infected teeth. These cases must be the most convincing, if they were selected among many for presentation to physicians.

CASE 1 (Wilmer).—Miss L. B., aged 52, was seen on Oct. 16, 1919. Ten months before, vision in the left eye was practically gone. A competent oculist made a diagnosis of detached retina. "Since that period the sight had improved somewhat." But just after these words, Wilmer stated that acuity of vision of the left eye was 20/40.

There was a large plaque of exudative choroiditis lifting the retina above the rest of the fundus. After extraction of two teeth and treatment for shallow pyorrhea, involving other teeth, improvement in vision was noticed within two weeks. Local treatment consisted of hot applications and ethylmorphine hydrochloride.

In Wilmer's opinion, the "quick" recovery after the extraction leads one to believe that the diseased teeth were the cause of the choroiditis.

Is this case convincing? I do not believe so.

First, it is an unusual case. In cases of retinal detachment not many physicians are so fortunate as to see such an improvement as has been recorded by Wilmer. Spontaneous reattachments of detached retina are quite rare.

Second, improvement was not rapid. The condition had lasted for ten months, and the vision had increased from almost no vision to 20/40 before the extraction had been performed. One can assume that as soon as recovery has been advancing, the further absorption of the exudate would follow in a short time without further treatment.

Third, in cases of uveitis, iritis or cyclitis, blood-letting by leeches or Heurteloup's apparatus is sometimes effective because the venous circulation in the orbit and eye is influenced by the circulation in the facial veins and also in the transverse sinus.

I recollect a case from my practice in Boston in which a woman suffered from a severe attack of iridocyclitis with sleepless nights and

10. MacCallan, C. B. E.: Toxic Absorption Due to Focal Septic Lesions, Eye, Ear, Nose & Throat Monthly **8**:25 (Feb.) 1930.

pain. She had been treated for a few weeks before I saw her. The pupil remanied contracted, despite the use of atropine. Leeches were applied to the temple. The pupil dilated, and the patient slept well for the first time in many days. She recovered completely shortly afterward. Therefore, I can assume that the bleeding could be the cause of improvement in Wilmer's case.

Fourth, post hoc does not mean propter hoc.

Fifth, local treatment was also applied.

CASE 2 (Wilmer).—In this case there was loss of vision in the right eye with a complicated calcareous cataract. Four years before the patient was seen by Wilmer, a cataract in the left eye was successfully extracted. From the history it is not known whether the postoperative period passed without the development of a uveitis. In this case there was a secondary cataract, and Wilmer made a discission. On the fourth day symptoms of a uveitis with a hypopion appeared. Within forty-eight hours after the abscessed tooth was drained, the eye began to improve. By the end of ten days the eye was normal.

Is this case convincing? I do not believe so.

I have had in my practice a number of cases in which uveitis with hypopion was observed after extraction of the cataract. The usual treatment resulted in satisfactory vision.

The following case in my practice is most instructive:

Five years ago a young lawyer called at my office on account of a uveitis in the left eye. Formerly, he had had pain in the joints without swelling. The pupil was contracted, but became dilated under the administration of atropine. The vitreous was opaque, and the fundus was seen with difficulty. Within two days a hypopion developed, with severe pain and complete loss of vision. Under treatment (atropine, acetylsalicylic acid, diaphoresis, hot applications), the hypopion disappeared within a few days, and there was complete recovery in three weeks. I did not use leeches or extract any teeth. Urinalysis and the Wassermann test gave negative results.

In a year he came to me because of a similar attack in the right eye. The same treatment again resulted in recovery within three weeks. The patient is a brother of a well known physician in Boston. I presume that he consulted another oculist, or perhaps on the advice of his brother all his teeth had been removed; so at 32 years of age he wore two plates.

After nine months, he had a severer attack in the left eye of five weeks' duration. There was a hypopion. About three years passed without attacks.

A few months ago he called at my office with a very slight pericorneal injection of one eye. The contracted pupil became dilated under the administration of atropine, the vitreous was transparent, the fundus hyperemic, and vision was almost 20/20. Next day the vitreous was opaque, and vision was 15/200. On the third day, there was complete loss of vision; the vitreous was opaque and there were pericorneal injection, hypopion and pain. Within three days the hypopion disappeared. It took three weeks for complete recovery.

Does not this case prove that hypopion in cases of uveitis may disappear quickly under local treatment, and that the extraction of all

teeth had no influence on the disease? Why should one believe that in Wilmer's case it would be different?

CASE 3 (Wilmer).—The ophthalmoscopic examination showed the disks a trifle pale with slight blurring of the margins. Spots of chorioretinitis were scattered around the disk and macula. Following the extraction of two teeth there was an increase in vision of from about 5/200 to 20/200. Local treatment consisted of hot applications and ethylmorphine hydrochloride.

Is this case convincing? I do not believe so.

The picture points to a chorioretinitis with neuritis and atrophy of the optic nerves. The inflammatory condition of the nerves might have been relieved by blood-letting incident to the extraction of the teeth and by the local treatment. This may account for the increase of the central vision. The increase in vision to 20/200 is not much, and one knows that in cases of retinitis pigmentosa or amblyopia nicotiana such decreased vision sometimes remains for a surprisingly long time. Sometimes slight fluctuations in the acuity of vision are observed.

I do not see much difference between the visual fields of this case taken before the extraction of teeth and after. It is well known that slight differences are found, if the fields are examined several times. It is necessary to take into account the patient's concentration, fatigue and intelligence, also the illumination and others factors. Therefore I cannot believe that in this case there was an objective improvement in the fields.

Einstein's theory of relativity is particularly applicable to statistics. In Wilmer's opinion, the three cases that he has reported are examples of ocular lesions that result from diseased teeth. In my opinion, they are not convincing, and should be excluded from the cases of ocular diseases due to dental sepsis. If all the published cases were carefully scrutinized, I believe it would be found that many of them have nothing to do with focal infection. But even if one accepts the statistics of the supporters of the theory, one comes to the conclusion that the cases in which the diseases did not yield to the elimination of infected teeth and tonsils are by far in the majority. For instance, Bulson [11] found that 32 of 100 cases of iritis were due to diseased teeth. Irons and Brown [12] found that of their series of 200 cases of iritis 27 could be attributed to the teeth alone or to the teeth in association with other sources of infection. In 1926, Elschnig [13] reported that in 12 of 29

11. Bulson, A. E., Jr.: Etiology and Treatment of Endogenous Iritis: Analysis of 100 Private Cases, Tr. Am. Ophth. Soc. **23**:292, 1925.

12. Irons, E. E., and Brown, E. V. L.: The Etiology of Iritis, J. A. M. A. **66**:1840 (June 10) 1916; **81**:1770 (Nov. 24) 1923.

13. Elschnig, A.: Etiology of Iridocyclitis, Klin. Monatsbl. f. Augenh. **75**:130, 1925.

cases of iridocyclitis, alveolar pyorrhea and apical abscesses were the cause.

This means that in the great majority of cases extraction of the teeth would be an unnecessary operation. However, one must remember that "there is no tissue of the eye that is immune to disease from diseased teeth (Wilmer)," and that the teeth may be infected, even if it is not established clinically or roentgenographically (Rice). Therefore, to be consistent, the treatment for ocular diseases should start with elimination of all teeth. Otherwise there will always be a possibility of keeping in the mouth a tooth that may be the cause of ocular disease. What a consistent but awful suggestion!

Reflex neuroses due to the teeth will be considered next. There were observed cases of amblyopia, complete blindness, blepharospasm, paralysis of the external ocular muscles, mydriasis, asthenopia, and other conditions. Unless one is dealing with hysteria, I cannot explain such cases. A reflex blindness can be assumed if the visual centers or the retina and the optic nerves are temporarily depressed from a reflex. In cases of paralysis the cerebral centers must be depressed. But so far as I know there was no scientific proof that irritation of the trigeminus produces such depression. Without such a proof, if one does not believe in miracles, one must assume that these cases are hysterical. Not long ago I read that after extraction of several teeth, a woman in Chicago began to see with an eye that had been blind for fifteen years. The *Boston Transcript* wittily remarked that, if a jawful would have been extracted, the patient might be able to see things which are not real.

I had in my practice cases of hysterical blindness in which I obtained complete recovery in a few days by using the noise of the motor of an electric multostat and making the patients believe that they were treated with electricity and that they must regain their sight in a few days. Usually, they complain of blindness in one eye.

With all my respect for Wilmer's achievements, I do not share his views on the relation of focal infection to ocular diseases in the broad sense in which he regards the issue. I do not wish to be misunderstood. I am not defending the retention of diseased teeth or tonsils; of course, they should be removed, if they cannot be improved. This applies to the teeth or tonsils just as it does to any other diseased organ that cannot be improved and that should be removed, if removal is permissible. But I am not in favor of operations performed in order to cure a disease in a distant organ. The influence of focal infection should be scientifically proved before such operations are employed. One cannot deny that the mouth may be a source of ocular diseases. The mouth is in communication with the nose and through the lacrimal

passages with the conjunctival sac. To be sure, the constant flow of the tears into the nose prevents the micro-organisms from ascending into the conjunctival sac. But it is remarkable to what extent the human organism defends itself against infection.

Twenty years ago, in hospitals for ocular diseases the percentage of infections following the extraction of cataract and other ocular operations was surprisingly small. Methods of asepsis and antisepsis were used without elimination of foci of infection. Some surgeons did not change the bandage for from three to five days, causing stagnation of the tears and making it easier for the germs to ascend into the conjunctival sac. Does it not prove that the importance of focal infection in cases of postoperative infection has been overrated? If one gets still better postoperative results now, it is because the technic has improved.

CONCLUSIONS

The clinical observations that confirm the theory of focal infection are lacking in persuasibility. One must admit that in some cases of ocular diseases improvement or cure follows the extraction of teeth. But this fact is not sufficient in itself to prove that the ocular disease was due to infected teeth. It is probable that one could obtain the same beneficial results in a less objectionable way.

In some cases of ocular diseases the improvement after elimination of the teeth may be a coincidence; in some it may be due to blood-letting, and in some to the psychic impression that the extraction of the teeth must have on nervous people, especially on those that suffer from hysteria. In the aforementioned case of Cushing's in which a tumor pressed on the chiasm, the patient felt better after the extraction of the teeth.

As I pointed out, some promoters of the theory of focal infection demand elimination of all foci. This means operations, operations and operations. But one has to remember:

1. There have been cases of death from extraction of teeth, tonsils and other operations.

2. There have been serious complications after such operations, for instance, Ludwig's angina and hemorrhages.

3. Iridocyclitis and choroiditis have followed the extraction of infected teeth (Wilmer).

4. Occasionally the extraction of severely infected teeth seems to cause an exacerbation of the ocular inflammation for a short time, and occasionally extraction causes serious complications (Wilmer).

5. In numerous cases of failure to achieve beneficial results, one is adding to the sufferings of the patient.

6. By removing the teeth and tonsils one is opening, by cutting the vessels, a raw surface which may absorb pathogenic micro-organisms and produce toxemia and embolism.

7. The operation weakens the patient temporarily and may lead to rise of temperature.

8. Beneficial results in some cases may be obtained simply by applying leeches or Heurteloup's apparatus.

9. It is deplorable to see girls and boys with plates instead of teeth.

10. The duty of the physician is to preserve and not to destroy. All that can be preserved should be preserved.

I am in full agreement with Everett L. Goar's [4] answer to Bahn, in which he said:

> In our present state of knowledge we may remove the tonsils, sacrifice all the teeth, drain the gallbladder, exenterate the sinuses, massage the prostate and so on ad infinitum, and the iritis recurs or the scleritis persists, or the chorioretinitis breaks out in a new place.

As for the theory of focal infection, one must confess knowing that one does not know. There is no shame in recognizing the truth. It is a grave mistake to consider the goal reached when it is far away.

Billings,[14] speaking against therapeutic vaccination, said:

> Based upon the work of Wright, but disregardful of the principles developed by him, therapeutic vaccination has progressed in this country into an irrational fad which is intensified and made degrading to the medical profession and harmful to the patients by commercial greed.

Billings was not quite right. The medical profession, as a whole, maintains high moral standards. A few unscrupulous physicians would not be able to succeed in the task of spreading a fad, if the latter were not based on a sincere belief of a large number of physicians that the new current theory is right.

Mutatis mutandis: substituting Billings for Wright, and unnecessary surgical intervention for therapeutic vaccination, a believer in vaccine therapy could apply Billings' statement to the theory of focal infection. In cases in which neither surgical procedure nor vaccine helped, which was more harmful to the patient, operation or vaccination?

It is true that the speculation of today may become the knowledge of tomorrow. But it is equally true that many speculations of the past have not become the knowledge of today, and have been buried in the waters of Lethe. Let us delay the practical application of the theory of focal infection until it has become knowledge.

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14. Billings (footnote 2, p. 154).

THE BEHAVIOR OF THE VITREOUS UNDER DIFFERENT HYDROGEN AND HYDROXYL ION CONCENTRATIONS

A STUDY IN VITRO *

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Many investigators have reported changes in intra-ocular pressure when the eye, in vitro or in vivo, was subjected to treatment with acids or alkalis. Fischer [1] instituted such investigations. He used whole eyes of sheep, oxen and pigs from which the connective tissue and the muscles had been removed. After the eyes had been weighed, they were kept in acid solutions of different strengths. At certain intervals they were removed from their respective solutions, dried with filter paper and weighed again. Increase in weight showed the extent of swelling, which was found to be proportional to the time of immersion and the strength of the acid. The greater the concentration of the acid, the greater was the swelling, and if the eyes were kept long enough in the acid solutions, they invariably came to the bursting point. Fischer observed also that the eyes swelled in pure water, but to a lesser extent than in acid, however dilute. This observation shows that at least a part of the swelling may be accounted for by osmosis, the ocular humors having a concentration of crystalloids of about 0.9 per cent, and the surrounding acid solution none. Furthermore, Knape [2] made sections through swollen eyes and found that the sclera and cornea had greatly increased in thickness. Ruben [3] made a similar observation, and in addition found that there was no increase in the volume of the vitreous. The protein of the relatively solid coats—the sclera, cornea and choroid—surrounding the vitreous must be at or near its iso-electric point at the p_H of the body fluids, whereas the protein of the vitreous is already in a state of turgescence at the same p_H. Thus only the coats may undergo various

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* From the Department of Ophthalmology, State University of Iowa.

1. Fischer, M. H.: Augenquellung und das Wesen des Glaukoms, Arch. f. d. ges. Physiol. **125**:396, 1908; **127**:1, 1909.

2. Knape: Skandinav. Arch. f. Physiol., 1910, vol. 23; quoted by von Fürth and Hanke (footnote 5).

3. Ruben, L.: Verhandl. d. ophth. Gesellsch. Heidelberg, 1912; quoted by von Fürth and Hanke (footnote 5).

degrees of swelling under an increased hydrogen ion concentration. At the same time, by their swelling, the coats of the eye are made more permeable to water, thus facilitating diffusion of water into the vitreous. It is even possible that, while the eye as a whole undergoes swelling under these conditions, the protein of the vitreous is decreased in volume. This is shown by the following experiment (described subsequently in detail): Twenty cubic centimeters of vitreous is measured into a collodion tube. The tube, with the contents, is suspended in an Erlenmeyer flask containing 475 cc. of hydrochloric acid with a p_H of 2.5. In about fifteen hours practically all the protein is precipitated, thereby occupying an extremely small volume. The volume of the total contents of the tube, however, has not decreased but, on the contrary, measures 21 cc., 1 cc. of fluid having been added by diffusion.

Fischer's work led Ruben [4] to carry out similar experiments on rabbits' eyes in vivo. He injected subconjunctivally 2 or 3 cc. of from 1:100 to 1:50 normal hydrochloric acid and observed a slight increase in intra-ocular pressure. Injections of 1 cc. of a stronger acid (from tenth-normal to third-normal) caused a much more rapid and pronounced rise in pressure, which reached its maximum in from three to ten minutes. An injection of 2 cc. of tenth-normal hydrochloric acid raised the pressure to 37 mm. of mercury. An injection of 2 cc. of third-normal acid produced a pressure of 134 mm. of mercury.

These results do not show, for the reasons already given, that the increase in pressure was due to swelling of the vitreous. Moreover, the results obtained by von Fürth and Hanke [5] strongly suggest that in all cases in which a transient increase in intra-ocular pressure was produced by injections of hydrochloric acid, the phenomenon was due to swelling of the sclera and cornea. Thus when von Fürth and Hanke made subconjunctival injections of dilute hydrochloric acid in vivo into rabbits' eyes, the pressure rose from 25 to 45 mm. of mercury and then rapidly descended to 15 mm., a subnormal pressure being maintained for several days. It was to be expected that the subconjunctival injection would affect the sclera and cornea more than the vitreous. On the other hand, when an injection was made directly into the vitreous, no increase in pressure occurred. On the contrary, the original tension of 33 mm. was reduced to 25 mm. in five minutes, and to 24 mm. in fifteen minutes. On another occasion, a similar injection of hydrochloric acid reduced the original pressure of from 24 to 27 mm. to 18 mm., but following this the pressure rose to 30 mm. in fifteen minutes. On only one occasion,

4. Ruben, L.: Beiträge zur Lehre vom Augendruck und vom Glaukom, Arch. f. Ophth. **86**:258, 1913.

5. von Fürth, O., and Hanke, V.: Studien über Quellungsvorgänge am Auge, Ztschr. f. Augenh. **29**:252, 1913.

and that after the other eye had undergone a similar treatment half an hour before, the original pressure of 27 mm. of mercury immediately rose to 48 mm., then fell to 40 mm. within fifteen minutes, and to 20 mm. several days later. An injection of sodium hydroxide into the vitreous resulted in an increase of pressure to from 34 to 50 mm. of mercury.

Meesmann,[6] on the basis of his experiments, maintained that the reaction of the aqueous influences the volume of the vitreous. He removed the aqueous in vivo from rabbits' eyes and replaced it by an equal amount of isotonic salt solution with a p_H between 6.2 and 7.0. In all cases the intra-ocular pressure dropped, reaching its minimum in from ten to thirty-five minutes. When the aqueous was replaced by an isotonic salt solution with a p_H between 8.1 and 8.3, the pressure invariably rose, reaching its maximum in from twenty to twenty-five minutes. The results obtained by Meesmann may mean that either the lens or the vitreous or both were affected.

The experiments by Redslob and Reis[7] center more specifically around the vitreous. These authors observed in vivo a distinct fall in the intra-ocular pressure of rabbits' eyes when isotonic solutions of hydrochloric or phosphoric acid were injected into the vitreous. Within thirty minutes the pressure fell to 15 mm. of mercury, and in a few hours to 10 mm. In ten days the tension started to rise, reaching normal in about thirty days. Injections of a sixth-normal sodium hydroxide solution into rabbits' eyes resulted in an increased tension for several hours. In control experiments, an injection of physiologic solution of sodium chloride caused a rapid rise of tension to 100 mm. of mercury or more. The tension, however, dropped to 30 mm. in about ten minutes. In experiments with gelatin solutions the increased tension following injection fell to normal in twenty-four hours, and then to a subnormal tension which persisted for about eight days. The results obtained in the experiments with acid and gelatin are identical, except for the differences in time required for the production and maintenance of the various degrees of tension.

From the foregoing results, one is prompted to make the following deductions: The vitreous gel appears to have been broken down under the influence of the acid into two mechanically separable parts: protein and an isotonic salt solution. According to Duke-Elder,[8] this should

6. Meesmann, A.: Ueber die Abhängigkeit des intraokularen Druckes von der Wasserstoffionenkonzentration des Kammerwassers, Arch. f. Augenh. **94**:115, 1924.

7. Redslob, E., and Reis, P.: Sur les variations expérimentales du tonus oculaire en relation avec les propriétés physico-chimiques du corps vitré, Ann. d'ocul. **166**:1, 1929; abstr., Brit. J. Ophth. **14**:470, 1930.

8. Duke-Elder: An unpublished paper.

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8. Duke-Elder: An unpublished paper.

cause a slight increase in the total volume of the contents of the vitreous chamber. He stated that the volume of the fluid plus the volume of the protein, uncombined in the form of a gel, is greater than the volume of identical amounts of the two components combined in the form of a gel such as exists in the normal eye. The pressure due to this condition is probably too small to be measured. The fluid liberated by the acid, however, is now free to leave the eye "by the drainage channels at the canal of Schlemm, the result being a decrease in the intra-ocular pressure." [8] Redslob and Reis showed by their control experiments with physiologic solution of sodium chloride that free fluid (uncombined with the protein in the form of a gel) is quickly eliminated from the vitreous; in ten minutes the pressure dropped from 100 to 30 mm. of mercury. It is possible, then, that the fall in pressure to 15 mm. of mercury, within thirty minutes after injections of hydrochloric or phosphoric acid, was due to the liberation and elimination of fluid from the vitreous. The elimination of a solution of gelatin, on account of its higher viscosity, required twenty-four hours. But once the drainage had started, the mechanism of elimination developed to such a degree that it continued working at an abnormally high rate for eight days.

The first systematic study of the vitreous in vitro with reference to changes in volume following changes in the reaction was carried out by Baurmann [9] in 1924. His method, in brief, was: A series of hydrochloric acid and potassium hydroxide solutions of different normalities was made up, the former ranging from ten thousandth-normal to normal, and the latter from ten thousandth-normal to tenth-normal. From 6 to 10 cc. of ox vitreous in a shallow dish was added to 40 cc. of the selected solution. The volume of the vitreous was measured daily in a small measuring cylinder, the acid and the alkali solutions being renewed at the same time. According to his graphs, the highest point of turgidity was reached at about three hundredth-normal alkali. On either side of this point the volume of the vitreous decreased, rapidly as the alkalinity of the solution was increased and slowly as the alkalinity was decreased and the acidity increased. The volume of the vitreous showed the greatest decrease in approximately fiftieth-normal acid solution, but in stronger acid solutions the volume again increased. It appears that Baurmann plotted changes in volume against the original normalities of the acid and alkali solutions. It will be shown subsequently that the reaction within the vitreous, at certain stages of

9. Baurmann, M.: Untersuchugen über die Eigenschaften des Glaskörpers des Tierauges und Bemerkungen über die Beziehungen zwischen Blutserum und intraokularer Flüssigkeit, Arch. f. Ophth. **114**:276, 1924.

turgescence, differs widely from that in the surrounding fluid, even if the vitreous and the reagent solution have been in contact for many hours. In order to obtain the true relationship between the volume and the reaction of the vitreous, one must determine the hydrogen and hydroxyl ion concentrations within the vitreous. In the main, Baurmann's results are reliable and bring out convincingly the fact that the volume of the vitreous is greatly influenced by its reaction.

Lobeck,[10] on the basis of his experiments in vitro, stated that no increase in the volume of the vitreous could be demonstrated by increasing the p_H to 8.35 when the vitreous was strictly fresh and was kept at body temperature during the whole process of experimentation. Not having carried out experiments under these conditions, we are not in a position to argue against Lobeck's observations. However, it may be pointed out that his method had certain flaws which seriously interfered with its sensitivity: The vitreous and the reagent solution were separated by a porous earthenware plate of rather coarse texture (grobporige unbearbeitete Tonplatte) and not by a semipermeable membrane. That part of the vitreous immediately in contact with the reagent solution (having a p_H of 8.35 at a temperature of 38 C.) was bound to become sufficiently fluid to be pressed, at least partially, through the pores of the plate and thus leave no record of increased volume. Another objectionable feature lay in the fact that only a small part of the surface of the vitreous was exposed to the reagent solution.

The chief emphasis in the present work was placed on a method by which it would be possible to study in vitro the behavior of the vitreous toward changes in the hydrogen and hydroxyl ion concentrations with greater accuracy than had been done previously. The method consisted of the following details: Hydrochloric acid solutions of different hydrogen ion concentrations were made up within the range of p_H 1.0 to the p_H of distilled water (7.0). This p_H range consisted usually of thirteen solutions of different hydrogen ion concentrations. The p_H range on the alkaline side was carried to approximately 9.5, and consisted of five or six solutions of different hydroxyl ion concentrations. In every experiment, 475 cc. of each solution was employed (in 500 cc. Erlenmeyer flasks). Such a large amount of solution was used in order to dialyze out the salts present in the vitreous to a negligible minimum and also to prevent a notable change in the p_H of the reagent solution.

Collodion tubes, 4 inches in length and 1 inch in diameter (10 by 2.5 cm.), were made by filling ordinary 50 cc. centrifuge tubes of

10. Lobeck, E.: Zur Frage der Quellbarkeit des Glaskörpers bei Veränderung seiner aktuellen Reaction, Arch. f. Ophth. **122**:668, 1929.

TABLE 1.—*Results with Salt-Free Reagent Solutions (18 C.)* *

Number	Original p_H	Outside p_H	Inside p_H	Final Volume After 15 Hrs., Cc.	Final Volume After 19 Hrs., Cc.	Filtrate After 19 Hrs., Cc.	Residue, Gm.
1	1.0	1.0	1.0	21.0	21.0	....	....
2	1.7	1.7	1.7	21.0	21.0	14.25	6.7
3	2.0	2.0	2.0	21.0	21.0	17.0	4.2
4	2.3	2.35	2.35	21.0	21.0	17.75	3.3
5	2.5	2.75	2.85	21.0	21.0	17.5	3.3
6	2.8	3.3	3.65	20.5	20.5	16.0	14.5
7	3.1	4.5	6.6	21.5	21.75	6.5	14.9
8	3.6	6.35	7.05	22.0	22.5	6.0	16.4
9	3.9	6.75	7.25	22.5	23.0	6.0	16.9
10	4.5	6.85	7.4	22.5	22.75	6.25	16.5
11	5.0	6.95	7.35	22.5	23.0	5.0	17.3
12	6.8	7.1	7.42	22.5	22.5	5.0	17.7
13	8.5	8.2	7.55	22.5	23.0	6.0	16.8
14	?	8.55	7.75	23.5	24.5	7.5	16.8
15	?	9.0	8.4	25.5	27.0	8.0	18.6
16	?	9.5	8.65	26.5	27.5	11.0	16.8
17	?	?	10.0 (approx.)	34.5	36.0	15.25	19.2

* This and the following tables contain data on the p_H values of the reagent solutions before and after their use, the p_H values of the filtrate of the vitreous, the final total volume of the vitreous, the amount of filtrate and the amount of the vitreous (residue) left on the filter paper at the end of the experiments. In all cases, 20 cc. of vitreous was employed.

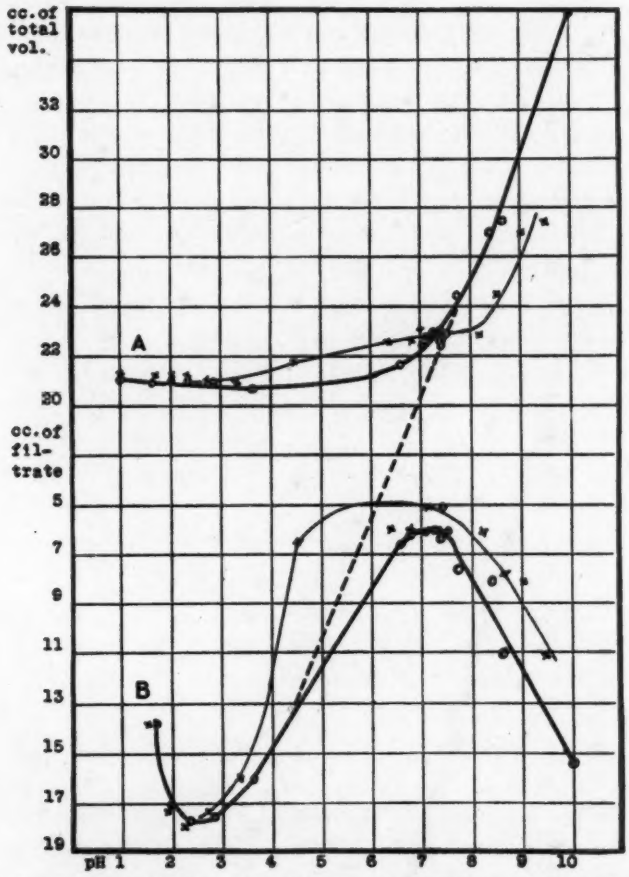


Chart 1.—Changes in the total volume of vitreous (*A*) and in the volume of filtrate (*B*) when salt-free reagent solutions at 18 C. were employed (based on data in table 1). In this and the following charts the fine line and the heavy line were obtained by plotting the outside p_H and the inside p_H, respectively, against the volume of filtrate (or weight of residue shown in chart 4).

TABLE 2.—*Results with Salt-Free Reagent Solutions (From 22 to 25 C.)*

Number	Original p_H	Outside p_H	Inside p_H	Final Volume, Cc.	Filtrate, Cc.	Residue, Gm.
1.....	1.3	1.2	1.2	21.0	7.5	13.5
2.....	1.5	1.5	1.6	21.5	7.2	13.9
3.....	1.7	1.8	1.8	22.0	14.0	7.3
4.....	2.0	2.1	2.15	21.0	16.5	4.6
5.....	2.3	2.35	2.5	21.5	17.5	3.5
6.....	2.5	2.8	3.0	21.5	17.0	4.5
7.....	2.8	3.4	4.1	21.5	14.0	6.7
8.....	3.1	5.05	6.6	22.3	7.0	15.2
9.....	3.6	6.3	....	25.0	7.5	17.7
10.....	4.15	6.85	....	26.0	8.0	17.6
11.....	5.2	6.85	....	25.5	5.8	18.7
12.....	6.0	6.85	....	25.5	7.0	18.2
13.....	7.85	7.0	....	25.5	7.5	17.5
14.....	8.1	7.1	....	26.0	6.5	19.5
15.....	8.7	7.4	....	26.5	8.0	18.3
16.....	9.0	7.85	7.6	26.0	7.5	18.6
17.....	9.3	8.45	7.65	28.0	9.0	18.4

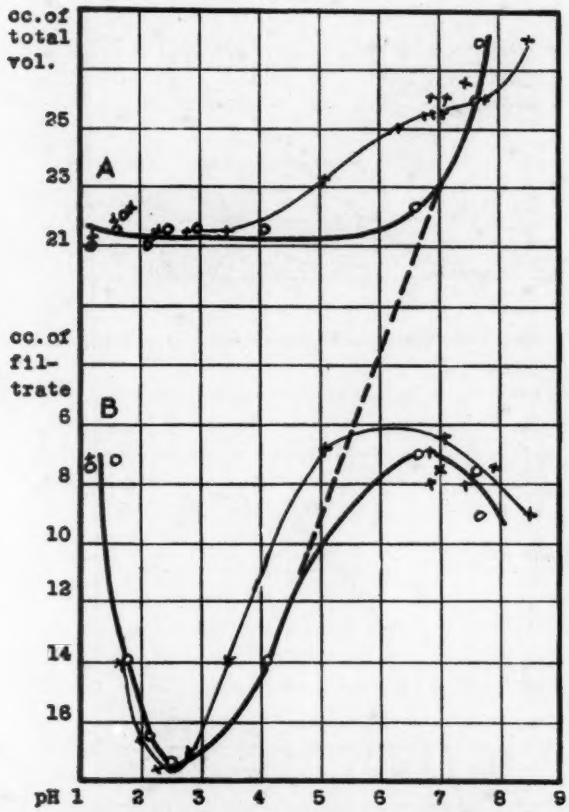
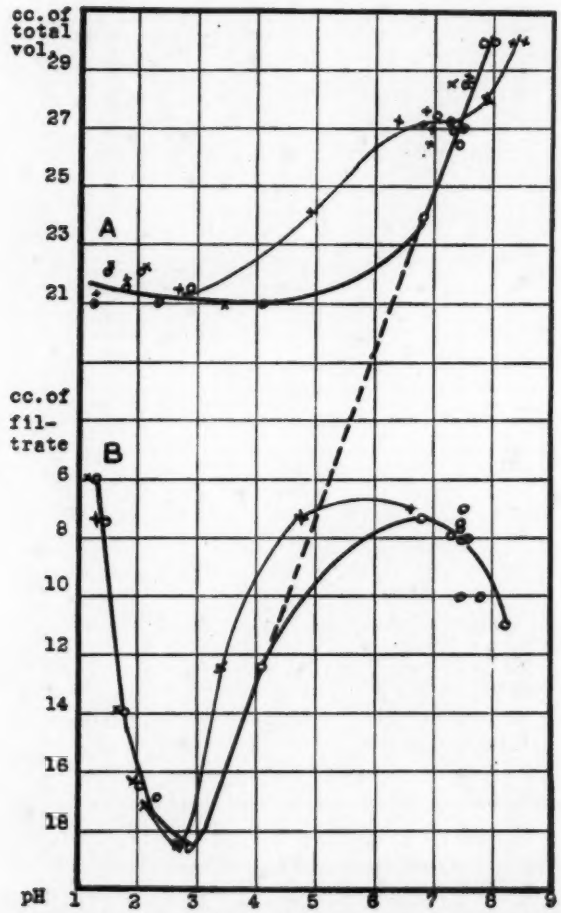


Chart 2.—Changes in the total volume of vitreous (*A*) and in the volume of filtrate (*B*) when salt-free reagent solutions at from 22 to 25 C. were employed (based on data in table 2).

TABLE 3.—*Results with Salt-Free Reagent Solutions (From 22 to 25 C.)*

Number	Original p_H	Outside p_H	Inside p_H	Final Volume, Cc.	Filtrate, Cc.	Residue, Gm.
1	1.3	1.3	1.3	21.0	6.0	14.4
2	1.5	1.5	1.5	22.0	7.5	14.3
3	1.7	1.8	1.8	21.5	14.0	7.6
4	2.0	2.05	2.05	22.0	16.5	5.3
5	2.3	2.4	2.35	21.0	17.0	4.0
6	2.5	2.7	2.9	21.5	18.5	3.0
7	2.8	3.4	4.1	21.0	12.5	8.1
8	3.1	4.7	6.8	24.0	7.3	16.2
9	3.6	6.3	7.3	27.3	....	....
10	4.15	6.7	7.45	27.3	7.5	19.2
11	5.2	6.9	7.45	26.5	7.6	18.0
12	6.0	6.8	7.45	27.5	8.0	19.1
13	7.85	6.95	7.3	27.0	8.0	18.4
14	8.1	7.3	7.5	28.5	10.0	18.3
15	8.7	7.5	7.6	28.5	8.0	20.0
16	9.0	7.85	7.5	27.0	7.0	19.1
17	9.3	8.2	7.8	30.0	10.0	19.7
18	...	8.5	8.25	30.0	11.0	19.3



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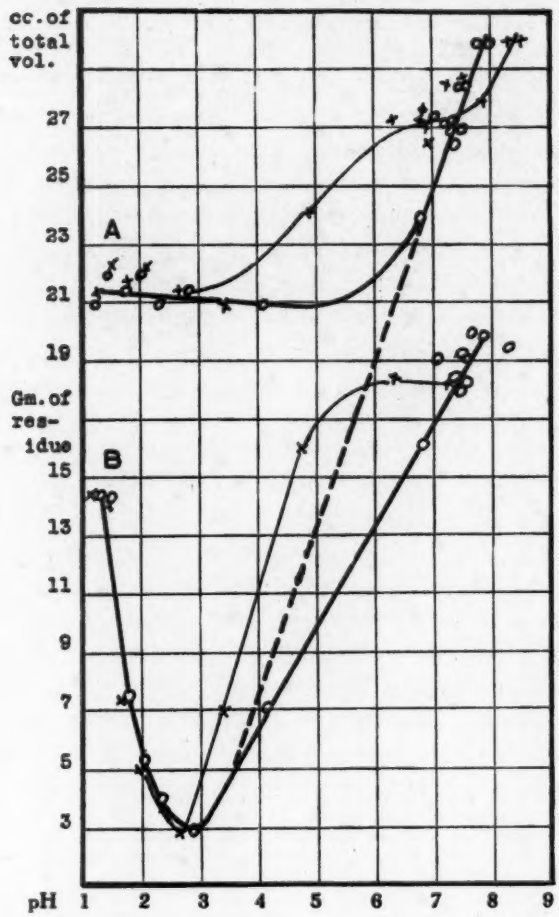

Chart 4.—Changes in the total volume of vitreous (*A*) and in the weight of residue (*B*) when salt-free reagent solutions at from 22 to 25 C. were employed (based on data in table 3).

TABLE 4.—*Results with Ringer's Solution (25 C.)*

Number	Original p_H	Outside p_H	Inside p_H	Final Volume, Cc.	Filtrate, Cc.	Residue, Gm.
1	1.0	1.0	1.0	21.0	7.0	14.3
2	1.7	1.7	1.7	21.0	8.0	13.3
3	2.0	2.1	2.1	21.0	13.5	7.7
4	2.3	2.5	2.9	21.0	15.25	5.8
5	2.6	2.9	3.1	21.0	15.75	5.6
6	2.8	3.1	7.0	21.25	6.25	15.3
7	3.1	4.4	7.1	21.25	7.0	14.6
8	3.5	6.2	7.5	21.25	8.0	13.2
9	4.5	6.7	7.4	21.0	8.0	13.3
10	6.8	6.8	7.4	21.0	7.5	13.6
11	?	8.6	7.7	21.25	7.5	13.9
12	?	9.0	8.4	21.5	9.0	12.2
13	?	9.5	8.7	21.5	9.0	12.7
14	?	?	9.2	21.75	10.5	10.9
15	?	?	10.0 (approx.)	22.5	14.0	8.6

TABLE 5.—*Results with Ringer's Solution (From 22 to 25 C.)*

Number	Original p_H	Outside p_H	Inside p_H	Final Volume After 16 Hrs., Cc.	Final Volume After 20 Hrs., Cc.	Filtrate After 20 Hrs., Cc.	Residue, Gm.
1.....	1.0	1.2	1.4	21.0	21.0	8.0	13.0
2.....	1.7	1.7	1.9	21.0	21.0	9.25	11.7
3.....	2.0	2.1	2.3	21.0	20.5	14.5	6.0
4.....	2.3	2.5	2.7	21.0	20.75	17.0	3.6
5.....	2.6	2.8	3.2	20.75	20.75	16.0	4.5
6.....	2.8	3.1	6.9	21.0	21.3	8.0	13.0
7.....	3.1	4.3	7.1	21.0	21.3	8.0	13.5
8.....	3.9	6.6	7.1	21.0	21.0	8.0	13.1
9.....	4.5	6.7	7.3	21.0	21.25	8.0	13.5
10.....	6.0	6.8	7.4	21.0	21.1	7.25	13.9
11.....	6.8	6.9	...	21.0	21.0	8.5	12.2
12.....	?	7.3	7.5	21.0	21.0	7.0	13.8
13.....	?	9.3	8.1	21.2	21.5	7.75	13.7
14.....	?	?	9.5	22.0	22.25	11.5	11.5
15.....	?	?	10.0 (approx.)	22.0	22.25	14.0	8.7

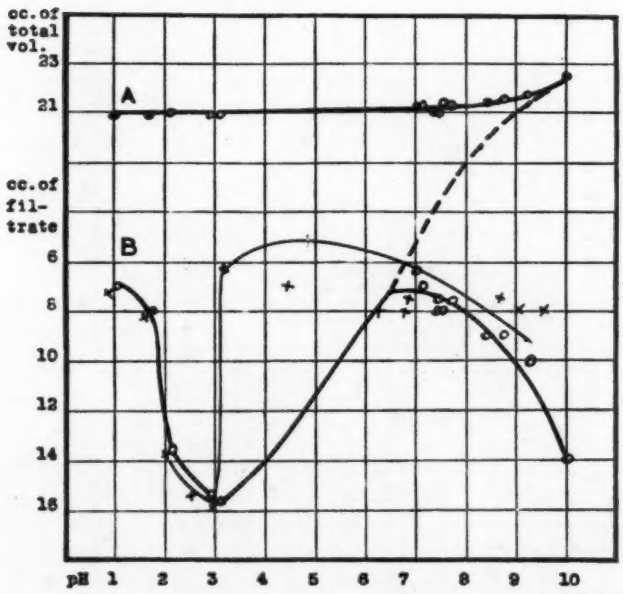

Chart 5.—Changes in the total volume of vitreous (*A*) and in the volume of filtrate (*B*) when Ringer's solution at from 22 to 25 C. was employed (based on data in table 5).

the same dimensions with an ether-alcohol solution of pyroxylin, and immediately emptying them. With the tube in an inverted position, about three or four minutes were allowed for solidification of the thin film on the inside. After cooling the tube by allowing tap water to run over the outside, while holding it in an inverted position, it was filled with water and the film carefully loosened. The collodion tubes were then kept submerged in water until used.

The vitreous of ox eyes was used in all experiments. Usually from two to four hours elapsed between the enucleation of the eyes and the removal of the vitreous, but during this time the eyes were kept at a temperature slightly above the freezing point. The vitreous gel was broken up by a special liquefying apparatus and thus rendered sufficiently fluid to be sucked into a pipet. Exactly 20 cc. of the liquefied vitreous was pipetted into each of eighteen or twenty collodion tubes, and the latter with their contents were suspended in the necks of the Erlenmeyer flasks which contained 475 cc. of an acid or alkali solution of known p_H. A small quantity of powdered thymol was sprinkled on top of the vitreous to prevent bacterial growth. The flasks with their contents were allowed to stand at room temperature for from fifteen to nineteen hours. During each experiment the vitreous was stirred two or three times with a glass rod to accomplish a more thorough mixing with the hydrogen or hydroxyl ions coming from the enveloping solution. After the expiration of from fifteen to nineteen hours, the vitreous was again measured in a small graduated cylinder.

A rather rapid and regular increase in the volume of the vitreous was always found with an increase in p_H (on the alkaline side). When the surrounding solution was quite acid, i. e., at a p_H of 2.5 or immediately on either side of it, the protein separated out in the form of a white coagulum, the separation being more complete at 2.5, the iso-electric point of the protein. The change in volume of the protein on the acid side was therefore ascertained by filtering off the free fluid (liberated by the acid) from the coagulum or the mixture of coagulum with various amounts of gel (depending on the hydrogen ion concentration). In order to collect the total filtrate, short-stemmed funnels were used. The filtration time was limited to five minutes, since it was found that all the free fluid came through. The filtrates were received into small (25 cc.) graduated cylinders and the volumes recorded. It is evident that the iso-electric point of the vitreous protein must be associated here with the largest volume of filtrate, since the separation between the protein and the fluid had to be more complete at this point than elsewhere. In the words of Duke-Elder,[11] the iso-electric point of a protein is at that hydrogen ion concentration "at which ionization,

11. Duke-Elder, W. S.: The Factors Controlling the Intra-Ocular Pressure, Proc. Roy. Soc. Med. **21**:817, 1928.

conductivity, osmotic pressure and turgidity (equivalent to volume) are at a minimum." In order to check the results obtained by measuring the volume of filtrate passed in five minutes, the residue on the filter paper, including the filter paper in each case, was weighed and the weight recorded, and in one experiment plotted against the p_H (chart 4). In plotting the volume of the filtrate against the p_H, one must keep in mind that the shrinkage in the gel is inversely proportional to the volume of the filtrate. Beginning with the iso-electric point on the acid side and going upward on the p_H scale, the amount of filtrate rapidly decreases up to a p_H of 7.0; then it just as rapidly increases (charts 1*B*, 2*B*, 3*B* and 5*B*). The total volume of the vitreous increases at the same time, as is seen from the curves obtained by plotting the volume of the entire contents of the collodion tubes against the p_H (section *A* of charts). This means that, beginning with a p_H of about 7.0, the vitreous absorbs water rapidly with an increase in alkalinity, thus converting the gel into a true solution which passes through the filter paper with increasing rapidity.

The flatness of the curve between p_H 1.0 and 7.0, when the total volume is plotted against the p_H (charts 1*A*, 2*A*, 3*A* and 4*A*), shows that on the acid side, while profound changes in the volume of the gel are taking place (section *B* of charts), little or no change is shown in the total volume, since the volume of the fluid remains relatively constant. In all cases, however, about 1 cc. of fluid was absorbed from the outside solution, probably as a result of osmotic pressure produced by solids in the vitreous.

A unified picture of the behavior of the vitreous gel may be secured by combining the curves obtained in the two procedures (measurement of both the total volume and the volume of the filtrate of the vitreous). This is done in the following manner, taking chart 1 as an example: The lowest point in the lower curve is placed 17.75 units below a corresponding point in the upper curve, since 17.75 cc. of fluid filtered through. The distances between other corresponding points in the two curves, within the range of 1.0 and 7.0 on the abscissa, are roughly proportional to the amounts of fluid that were filtered off. The line connecting the lowest and highest points (discontinuous in its middle portion) indicates the change in volume of the vitreous gel owing to changes in p_H between 2.5 and 10.0. In other words, if the protein at its iso-electric point were completely reversible in its reaction toward decreasing concentrations of acid and increasing concentrations of alkali, it would increase in volume, when its p_H was gradually raised from 2.5 to 10.0, by absorbing water to the extent indicated by the steepness of the line (p_H 10.0 was estimated approximately by interpolation).

The distance between the highest point on the lower curve and a corresponding point on the upper curve is incidental, depending on the

permeability of the filter paper. By increasing the density of the filter paper, the peak of the lower curve could be raised to coincide with a corresponding point on the upper curve. Similarly, the straight heavy solid line in chart 4*B* could be made to coincide with the discontinuous line. That would naturally raise the lowest point also, but to a much lesser extent, since the viscosity of the fluid endeavoring to pass through the filter paper is at a minimum at this point.

The p_H of the vitreous, as well as that of the enveloping solution, was determined at the end of the experiment. The p_H values of the two fluids more or less coincide in the region of neutrality and in the regions of high concentrations of acid and alkali. Between these regions the p_H values differ widely, but the vitreous always shows a lesser concentration of hydrogen and hydroxyl ions than the outside solution. In determining the p_H of the contents of the collodion tubes, a filtrate was used except on one occasion.

Increase in temperature appears to accelerate the absorption of water by the vitreous, as is shown by a comparison of charts 1, 2 and 3. From chart 1 it is seen that, at a temperature of 18 C., the volume increased from 20 to 23 cc., at a p_H of 7.5; whereas at a temperature between 22 and 25 C. and at the same p_H, the increase is from 20 to 26 and 27 cc. (charts 2 and 3).

Two experiments were carried out in which the reagent solutions contained sodium chloride, potassium chloride and calcium chloride in amounts comparable to Ringer's solution. The absorption of water by the vitreous on the alkaline side was greatly inhibited, as shown in chart 5. The salts, however, had less influence on the dehydration of the protein in the region of its iso-electric point, apparently due to the relatively high hydrogen ion concentration in this region. It was found also that the presence of these salts tended to shift the iso-electric point toward a lower acidity, it being at p_H 2.7 in the first experiment, and at p_H 3.1 in the second experiment.

The research was confined to the p_H range between 1.0 and 9.0 on account of the limitations of the apparatus for hydrogen ion determination. The p_H determinations were carried out with the quinhydrone electrode and saturated mercurous chloride cell as used with the Hydrogen Ion Determination Apparatus furnished by Leeds and Northrup Company, Philadelphia.

SUMMARY AND COMMENT

The aim of this work was to develop a method by which the degree of turgescence and deturgescence of the vitreous could be accurately measured under different hydroxyl and hydrogen ion concentrations in vitro, and furthermore to determine such variations in the volume of the vitreous.

It was found that the vitreous gel, if dialyzed against large amounts of salt-free hydrochloric acid and sodium hydroxide of various concentrations within the p_H range of from 1.0 to 9.0, readily loses its water or absorbs more water with increasing concentrations of the acid and alkali, respectively. Increase in temperature accelerates these changes in volume.

The internal structure of the vitreous provides a fairly efficient protective mechanism against the effect of changes in the hydrogen or hydroxyl ion concentrations in the surrounding media. Even when the gel was broken up by artificial means it absorbed only a part of the excess of the hydrogen and hydroxyl ions of the surrounding liquid, except when the acid or the alkali was of such strength that it had completely coagulated or dissolved the protein. The presence of salts seems to provide another protective mechanism against absorption of hydrogen and hydroxyl ions by the protein. This is seen by comparing the differences in p_H between the salt solution outside and the vitreous inside the collodion tube in Ringer's and in salt-free solutions. These differences were especially great when the original Ringer's solution had a p_H of 2.8. Table 4, for example, shows the inside p_H to be 6.9 when the outside p_H was 3.1, a difference of 3.8. In table 5 the inside p_H is given as 7.0 and the outside p_H as 3.1, a difference of 3.9. The salt-free acid solutions, on the other hand, as is seen from both tables 2 and 3, had a p_H of 3.4, and the vitreous inside the collodion tube had a p_H of 4.1, there being a difference here of 0.7. This difference is still less between corresponding data of table 1, being only 0.36.

With the results of this work we do not claim to have answered the question as to whether certain types of glaucoma may be traced to an increase in alkalinity of the ocular humors. These experiments, however, give a more systematic and clearcut idea of the sensitivity of the gel, when in a relatively fresh and salt-free state, toward changes in hydrogen and hydroxyl ion concentrations. The vitreous gel may be pictured in its normal condition as a very sensitive balance in equilibrium. On one side there is its extreme sensitiveness toward water, to combine or to part with it, under the slightest change in the hydrogen or hydroxyl ion concentrations; on the other side there is its homogeneous, superfine structure plus a certain concentration of salts and other crystalloids. The least disturbance on either side will bring the balance into a violent oscillation, but will not injure it. If, however, such disturbances occur frequently for a long period of time, they will leave behind some defects in the structure. Changes in p_H, in the concentration of salts, in carbon dioxide content and in the permeability of the capillaries of the bulbus oculi with a subsequent infiltration of toxins are a few of the disturbances which may be enumerated. In

spite of the protective mechanism, a change in p_H will tend to produce some change in the structure of the vitreous, and a much greater change will be produced if the concentration of salts happens to be subnormal. The cause, in this case a reversible chemical reaction, will be removed by a counter reaction more rapidly than will the effect, which is more or less a physiologic condition. Thus an accumulation of effects can take place more readily than an accumulation of causes. Swelling of the vitreous, in a certain sense, may be regarded as a counteraction which results from an effort to maintain a normal p_H, for the protein tends not only to absorb the alkali radicals and hold them in combination but also to absorb water and reduce their concentration. Therefore, when we find in glaucoma a normal p_H, it is no proof that a change in p_H did not play a rôle in bringing about the condition.

TEST TYPES FOR ESTIMATING WITH WORTH'S AMBLYOSCOPE THE VISION OF MALINGERERS *

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CHICAGO

While the fact that a patient is simulating poor vision is usually easy to detect, it is sometimes difficult to estimate exactly how much vision is present in the eye that is claimed to be defective. The use of a strong plus lens over the good eye while the patient reads with both eyes (Dujardin's test) is effective in most cases during the novitiate, and even better is the use of two strong cylinders of opposite axis, one of which is turned during the test, as suggested by Jackson. The practiced malingerer, however, often learns that these tests can be evaded by closing either eye for an instant. On a patient of this type, who claimed only perception of shadows in the right eye and who was not deceived by the usual tests, Worth's amblyoscope was tried, with the tubes converging, so that the image of the right eye appeared far to the left. The illusion that this image was seen by the left eye was so overpowering that the patient at once stated that he saw this image and claimed not to see the other image, corresponding to the left eye. This gave convincing evidence of malingering, but on account of the size of the pictures furnished with the amblyoscope, it could not be proved that the vision of the right eye was more than 20/200. Hence I had a set of semitransparent cards made to fit the amblyoscope with print and numbers of various size corresponding to vision of from 20/200 to 20/20. The visual angles were calculated by Mr. R. S. Copeland of the Riggs Optical Company, to correspond with the length of the amblyoscope tubes. The vision corresponding to the test types is printed at the side, where it is covered by the slots in the amblyoscope tubes. Cards with numbers are also furnished, as these are more easily read than letters by certain races or by partially illiterate persons. These charts are, of course, mirror images, since they are corrected when seen through the amblyoscope. The notations of vision at the side have been printed as mirror images by mistake, but are easily deciphered. A single line of letters and numbers is used, as it was thought that any type requiring a longer time to read might give the patient time to solve the problem by closing an eye. The whole idea in this test is that of at once convincing

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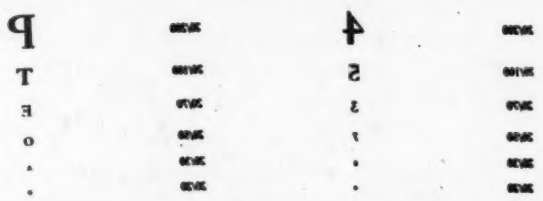
* From the Department of Ophthalmology, Northwestern University Medical School.

the patient that the image of the supposedly defective eye is seen by the other eye and hence should be read. In a recent case a patient who claimed vision of shadows in one eye was shown by these charts to have a vision of 20/30. This information was especially valuable in this case since the patient had already been passed by his local railroad examiner as having complete loss of vision in this eye, the pupil being widely dilated and not reacting to light. He came to me when trouble seemed to be developing in the other eye. This was found to be due to his putting lime and sand into the conjunctival sac, while the mydriasis was brought about by atropine, which was found in his belongings.

Since these cards were made, an article by Thies[1] has appeared describing a modification of Gratama's tubes, used by the Dutch military surgeon 100 years ago for the same purpose. These tubes embody the same principle, but are placed at the end of a long holder. While this allows of using larger type, it requires a special instrument, though a simple and inexpensive one. The "Malingeroscope" sold by some



optical houses may also be useful, as the holes are placed so that by turning one tube the examiner shuts off the image of one eye without the movement being perceived. The apparatus with movable mirrors, such as that of Fridenberg, utilize the same principle as the amblyoscope. A number of such tests were described by Wood.[2] He used Worth's amblyoscope for the purpose of detecting simulation, depending on the pictures furnished with the amblyoscope to give a rough idea of the vision. Since so many ophthalmologists have the amblyoscope in their equipment, it seems that these test types which are adapted to it and with which the vision can be accurately determined may serve a useful purpose.

1. Thies: Arch. f. Ophth. **123**:691, 1931.

2. Wood, Casey: American Encyclopedia of Ophthalmology, Chicago, Cleveland Press, 1913, vol. 2, p. 1176.

GLIOMAS OF THE RETINA

INCLUDING THE RESULTS OF STUDIES WITH SILVER IMPREGNATIONS *

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CHICAGO

Although primary retinal tumors were recognized clinically for many years, their pathologic nature was long uncertain. They were classified as to their stage of growth: early as fungus medullaris, and late as fungus haematodes. Von Graefe [1] was doubtful as to their essential nature and believed them to be hyperplasias of the retina, carcinomas or sarcomas. It was not until 1864 that Virchow first considered these primary retinal tumors as gliomas arising from preexisting glia cells of the retina and analogous to gliomas of the brain. However, he also described their malignant transformation into gliosarcomas. In 1868, Hirschberg and Knapp independently defined the histologic picture of the primary tumors and their metastatic growths as being purely gliomatous and never sarcomatous.

All the primary epithelial tumors of the retina were called gliomas, in spite of the fact that they obviously did not have a homogeneous histologic structure, until Flexner [2] separated out a type of tumor which he termed neuro-epithelioma. From an analysis of the cases reported in the literature two other distinct types of gliomas may be recognized: the medulloepitheliomas and the retinoblastomas.

Embryologically, the retinas and optic nerves arise from evaginations of the primitive cerebral vesicle, and at that period of their development have a cell structure identical in type with the primitive medullary epithelium of the neural tube. The adult retinal nervous elements are derived from a progressive development of these cells; figure 1 represents a diagram of the probable stages of histogenesis of the adult retinal cells. By studying the predominating cell types in various tumors and correlating them with a particular stage of the histogenesis of adult nerve tissue, Bailey and Cushing [3] were able to make an orderly workable classification of gliomas of the brain.

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* Submitted for publication, Jan. 26, 1931.

* From the Division of Neurology and Neurosurgery, the University of Chicago.

1. von Graefe: Zur Kasuistik der Tumoren, Arch. f. Ophth. **10**:193, 1864.

2. Flexner, S.: A Peculiar Glioma (Neuroepithelioma?) of the Retina, Bull. Johns Hopkins Hosp. **2**:115, 1891.

3. Bailey, P., and Cushing, H.: A Classification of the Tumors of the Glioma Group, Philadelphia, J. B. Lippincott Company, 1926.

For such a detailed study of cellular types, specific methods of impregnations with silver salts must be used. In no other manner can the fine processes of nerve and glia cells be demonstrated. This technic requires the fixation and preservation of the tissue in a dilute solution of formaldehyde without the use of alcohol. Frozen sections are required for the specific stains, the technics of which are now easily available. The anatomic relations of the various gliomas to the ocular structures have been thoroughly studied by the use of material embedded in celloidin and cut in large serial sections, but further advance in the knowledge of the retinal gliomas requires fixation of the tumor tissue directly in formaldehyde and the use of special staining methods.

Although much more work must be done to complete the knowledge concerning gliomas, comparison of the cellular studies already made with the results of studies made on gliomas of the brain is profitable.

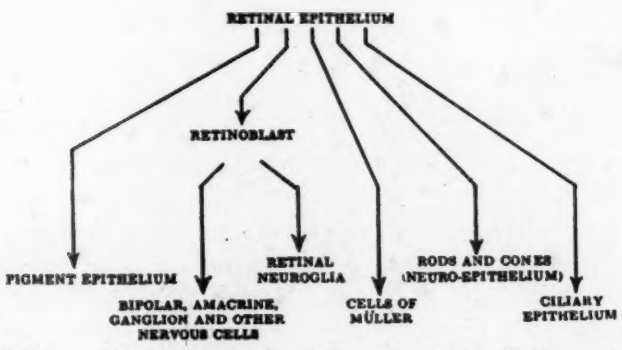

Fig. 1.—Schema of the histogenesis of the retina (after Bailey and Cushing).

Furthermore, I wish to describe in detail the results of a study of a retinal glioma by the use of silver impregnation. The recorded tumors of the retina may be divided as follows: those arising from the primitive retinal and ciliary body epithelium, the medullo-epitheliomas; those from the hypothetic bipotential indifferent retinoblast, the retinoblastomas, sometimes called retinocystomas, and those from the primitive spongioblasts or neuro-epithelium, the so-called neuro-epitheliomas.

Some descriptions of retinal tumors have mentioned the presence of a few ganglion cells which were probably incorporated into the tumor by its extension. No true tumors of the neuroblastic series have been described. Deutschmann [4] described what he believed to be a tumor of the pigmented epithelium, but Reis [5] showed that the pigment cells were passively involved, as in degenerative and inflammatory diseases. The

4. Deutschmann, F.: Ueber ein atypisches Netzhaut Gliom, Ztschr. f. Augenh. **27**:340, 1912.

5. Reis, G.: Kann die Abstammung des Netzhautglioma von Pigmentepithel der Netzhaut als erwiesen gelten? Ztschr. f. Augenh. **33**:174, 1915.

adult retinal glia, Müller's cells and the oligodendroglia (the last mentioned cells were recently described by Marchesani [6] and Enriquez [7] as occurring in the retina and optic nerve) have not been seen in tumors except possibly in tuberous sclerosis by van der Hoeve.[8] Elschnig [9] reported what he termed a neurinoma similar to that found in the peripheral nerves. His description and illustrations were such that this single report did not deserve its universal acceptance and frequent quotation in the literature. Tumors originating in blood vessels are not infrequently found in the retina, and considerable controversy has arisen as to whether they are in reality hemangioblastomas or vascular gliomas.[10] Careful study with specific methods shows that the primary central nodule is angioblastic, and that it has stimulated adjacent glial proliferation (fig. 2).

MEDULLO-EPITHELIOMA

Tumors arising from the medullary epithelium of the primitive neural tube and primitive retinal epithelium are rare. Bailey and Cushing had only two examples of this type, both from the area near the third ventricle where the primitive roof and floor plate of the neural tube persist in adult life (fig. 3). In teratomas the nervous tissue when present is usually in the form of medullary epithelium. In the retina, medullary epithelium persists in almost undifferentiated form throughout adult life in the epithelium of the pars ciliaris retinae, and it is from this tissue that medullo-epitheliomas of the retina usually arise.

The first recognition that these tumors were different from other retinal gliomas was by Schlipp [11] and by Emanuel,[12] who described a

6. Marchesani, O.: Die Morphologie der Glia in Nervus opticus dargestellt nach den Untersuchungsmethoden und Untersuchungsergebnissen, Arch. f. Ophth. **117**:575, 1926.

7. Enriquez, L.: Oligodendroglia de las vias opticas, Bol. r. Soc. españ. de hist. nat. **26**:1, 1926.

8. van der Hoeve, J.: Augengeschwülste bei der tuberösen Hirnsklerosen (Bourneville) und verwandten Krankheiten, Arch. f. Ophth. **105**:880, 1921; Augengeschwülste bei der tuberösen Hirnsklerose, Arch. f. Ophth. **111**:1, 1923.

9. Elschnig, A.: Zur Kenntnis der primären Retinal-Tumoren, Arch. f. Ophth. **87**:370, 1914.

10. von Hippel, E.: Ueber diffuse Gliose der Netzhaut und ihre Beziehungen zur der Angiomatosis retinae, Arch. f. Ophth. **95**:173, 1918. Brandt, R.: Zur Frage der Angiomatosis retinae, ibid. **106**:114, 1921. Berblinger, W.: Zur Auffassung von der sogenannten von Hippelschen Krankheit der Netzhaut, ibid. **110**: 395, 1922. Lindau, A.: Zur Frage der Angiomatosis retinae und ihrer Hirnkomplikation, Acta ophth. **4**:193, 1927. von Hippel, E.: Noch einmal zur Angiomatosis retinae, Arch. f. Ophth. **118**:348, 1927.

11. Schlipp, R.: Ueber einen epithelialen Tumor des Ciliarkörpers, Arch. f. Ophth. **28**:353, 1899.

12. Emanuel, C.: Eine Fall von Gliom der Pars ciliaris retinae, Virchows Arch. f. path. Anat. **161**:338, 1900.

case accurately and included excellent drawings of bands of cells rich in cytoplasm and containing dark-staining nuclei. In the bands the cells were several layers thick, and their nuclei lay in the portion of the cell closest to the interior of the band, but a protoplasmic border was present on either side of the nucleus. Degeneration of the cells was frequent, as evidenced by pyknotic nuclei and homogeneous staining of the cytoplasm. An external and an internal limiting membrane in the

Fig. 2.—Hemangioblastoma of the retina. The central nodule (*h*) is composed of a cluster of endothelial cells and is surrounded by proliferated glia (*g*). Hematoxylin and eosin; × 390.

bands and lumina were present, and connective tissue stroma was found between the bands.

Verhoeff's [13] instructive case contained the same elongated cells, in bands and convolutions with axes perpendicular to the surfaces, con-

13. Verhoeff, F.: A Rare Tumor Arising from the Pars Ciliaris Retinae (Terato-Neuroma) of a Nature Hitherto Unrecognized and Its Relation to the So-Called Glioma Retinae, Tr. Am. Ophth. Soc. **40**:351, 1904.

taining small, dark, centrally placed nuclei. In addition, vesicles were formed which in shape and type of cell duplicated almost identically the structure of small embryonic retinal vesicles. Even an attempt at vitreous formation was noted within them. Certain lumina contained knoblike processes extending beyond the cells into the central cavity, resembling rods and cones. These were typical rosettes composed of primitive spongioblasts with fine fibrils arising from them.

Cucchia [14] demonstrated in his case the same primitive columnar epithelium forming bands and lumina, and bipolar spongioblasts with fine delicate processes arising from their ends. Many small retinoblastic cells with large dark nuclei and scanty cytoplasm were arranged radially around the blood vessels. Mitotic figures and degenerative changes were abundant. Stroma and blood vessels were scanty. A few adult glia cells were also seen.

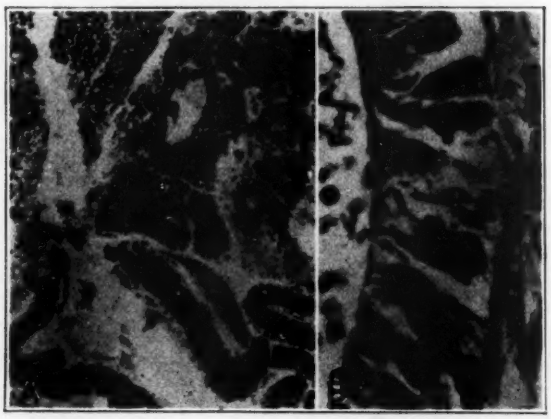

Fig. 3.—Medullo-epithelioma of the brain: *A*, long bands of cells are folded in places to form canals; *B*, the limiting membranes are visible (after Bailey and Cushing).

It would be expected that in a tumor composed of cells with the normal potentiality of developing into more differentiated cell types, some such differentiation into these types would be found. Correspondingly, in the medullo-epitheliomas, with the possible exception of Meller's [15] case, the tumors are in reality mixtures of cell forms and are composed of retinoblastic cells, neuro-epithelial rosettes and other spongioblastic cells with, however, medullary epithelium predominating

14. Cucchia, A.: Contributo alla conoscenze dei tumori della "pars ciliaris retinae," Ann. di ottal. e clin. ocul. **56**:577, 1928.

15. Meller, J.: Ueber eine epitheliale Geschwulst des Ciliarkörpers, Arch. f. Ophth. **85**:191, 1913.

(fig. 4). In Redslob's [16] and Verhoeff's [13] cases ependymal cells were also found, and Cucchia saw adult neuroglia cells.

In Meller's case there were columns of cells composed of double rows of simple cuboidal and cylindric epithelial cells, the nuclei of which were situated nearest the adjacent cell boundary. A moderate amount of connective tissue stroma lay between the columns of cells. Emanuel's [12] case showed what more closely resembled the primitive retinal vesicle, in that bands of tissue composed of many folds lay adjacent to each other, forming various indentations which anastomosed

Fig. 4.—Drawing of a medullo-epithelioma of the retina. The mixture of cell forms and arrangements is shown. There are bands of medullary, epithelium, neuro-epithelial rosettes and retinoblasts (after Cattaneo).

to enclose varied sized lumina. The large ones were oval and the small ones round, and they were formed by a radial arrangement of the cells. Where the lumina were less numerous the cells were more abundant, yet composed of the same oval elongated tumors; they were uneven, nodular and often apparently lobular, and the cut surfaces occasionally had a glandular appearance. Regressive changes were evidenced by

16. Redslob, N. E.: Neuroépithéliome gliomateux de la rétine. Contribution à l'étude de l'histogénèse des tumeurs rétiniennes, Bull. d l'Assoc. franç. p. l'étude du cancer **12**:1, 1923.

grayish-green softened spots, fatty areas of cheesy semiliquid substance or mucoid material. Large hemorrhages and calcifications were frequent.

These typical tumors are fundamentally composed of bands of columnar epithelium resembling the primitive medullary retinal epithelium, with evidence in the tumor of differentiation into retinoblasts and neuro-epithelium in the shape of rosettes, which will be discussed later, and bipolar spongioblasts, ependymal cells and even adult glia.

RETINOBLASTOMAS (RETINOMA, RETINOCYSTOMA)

Retinoblastomas form the vast majority of the retinal gliomas, and the usual descriptions found in the literature apply to this neoplastic type. The retinoblast is a hypothetic cell analogous to the medulloblast or bipotential cell arising from the medullary epithelium. The latter is bipotential in that its subsequent development may lead to a differentiation along the neuroblastic series to form ganglion cells or along the spongioblastic series to form adult glia. On this hypothesis, tumors of retinoblasts should contain evidences of attempts at differentiation in either direction. Neuroblasts have never been found in retinal tumors of this type, but modern methods of impregnation have rarely been applied to them (fig. 5).

The point of origin is usually from the posterior part of the retina, and even from the papilla. In general, the cells have an epithelial character, but they very early break through the tumor nodule and show an extensive power of infiltration. Orbital extensions, involvements of the base of the brain and distant metastases usually arise from the retinoblastomas. These tumors are the only known neoplasms of glial origin that metastasize to distant parts. Those of this type (the medulloblastomas) found in the brain do so to a lesser degree, in that they have a tendency to "infect" the meninges. This power of metastatic growth has no explanation, yet by virtue of the embryonic character of the cells a high grade of malignancy is to be expected.

The tumor consists of small, round and polygonal, often carrot-shaped cells containing scanty cytoplasm and usually closely packed together. The nuclei are large and dark-staining and have a definite chromatin network. Fine tail-like processes from one end of the more elongated cells are found in rare instances. Intercellular substance cannot be seen except for a fine reticular stroma. Mitotic figures are most abundant in this tumor.

In 1896, Greeff [17] studied retinal gliomas for the first time with the silver impregnation method of Golgi, modified by Cajal. This method is

17. Greeff, R.: Der Bau und das Wesen des Glioma retinae, Deutsche med. Wchnschr. 22:327, 1896.

not used today in the study of gliomas because it does not produce uniform impregnation; moreover, its action may affect any cellular element in the nerve tissue—it is nonspecific. Nevertheless, Greeff's drawings are reproduced, demonstrating that in his tumor, astrocytes and also possibly ganglion cells were seen. In figure 6 *A* and *B* are pictured what are probably fibrous and protoplasmic astrocytes with fairly large cytoplasm of angular shape and many processes. Vascular attachments of the processes were not described. In figure 6 *C* are cells which may

Fig. 5.—Retinoblastoma composed of small round darkly stained cells, closely packed together, in which there are many areas of degeneration. Hematoxylin and eosin stain; × 100.

possibly be ganglion cells, but in *D,* although Greeff called them small ganglion cells, the cells shown are probably oligodendroglia.

Urra,[18] by means of silver impregnations, was able to give the most accurate description of a retinoblastoma. In his tumor there were apparently three zones of tissue, which seemed to represent stages in the in situ histogenesis of the retinoblastic cells (fig. 7). The external

18. Urra, F.: Ueber die feine Gewebstruktur des Gliomas der Netzhaut, Arch. f. Ophth. **112**:133, 1924.

zone was composed of cells with scanty cytoplasm and large well developed argentophilic nuclei undergoing frequent simple mitoses. The cell shapes were lancet-like or pearlike, although fully rounded cells were also found. No reticulum could be seen, but there were numerous small-

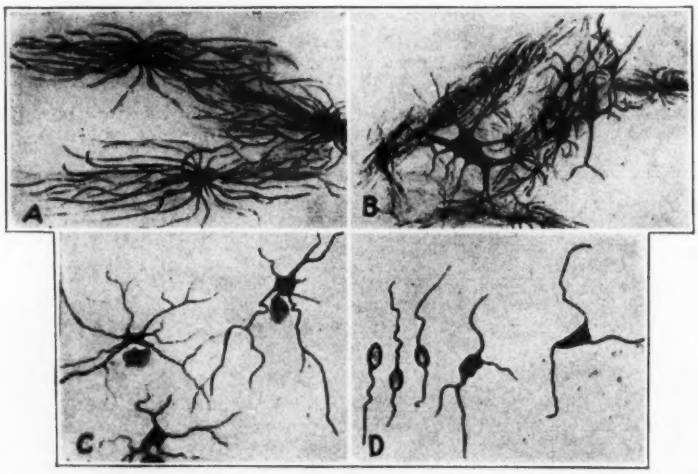

Fig. 6.—Drawings of a retinoblastoma impregnated by a modified Golgi method (after Greeff). *A*, glia cells. *B*, *C* and *D* show what Greeff called ganglion cells. Those of *B* are certainly neuroglia and those of *D* probably oligodendroglia.

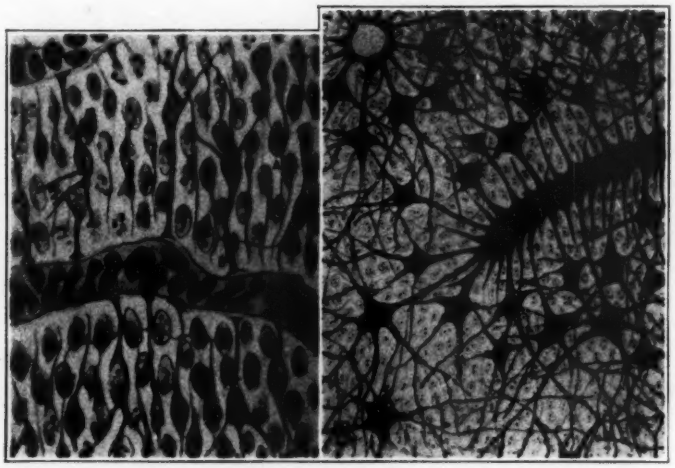

Fig. 7.—Glioma of the retina impregnated with silver carbonate. The cells in *A* are astroblasts with large sucker feet attached to the vessel walls. In *B*, the central zone of the same tumor is shown with fully developed astrocytes and gliafibrillae (after Urra).

channeled capillaries composed of single layers of endothelial cells. In the outermost portions of the tumor the capillaries were proliferating and mitoses of the tumor cells were frequent, but further inward degen-

eration of the capillaries was more common and mitoses were less frequent. In the intermediate zone the cells were more elongated, and their tail-like processes tended to become attached to the wall of a blood vessel in the form of a sucker foot. In the innermost zone typical adult astrocytes were seen with well developed sucker feet and two or three processes containing fibrils. Thus a local histogenesis in this tumor was described from the retinoblast to the spongioblast and adult astrocyte.

Although infrequently no particular radial arrangement of the cells may be found, they usually have a characteristic radial arrangement about the blood vessels in spokelike order. They thus resemble the rosettes of the neuro-epithelial tumors, but should be strictly differentiated from them because they radiate around blood vessels instead of clear spaces. These arrangements have been called pseudorosettes and are characteristic only of the tumors arising from the indifferent cells.

Degenerative changes, such as necrosis, fatty degeneration, calcification and even hemorrhages, are frequently found. The degenerative changes usually begin in those cells most distant from the blood vessels and may be demonstrated only as an inability of the cells to stain normally. The nuclei become pyknotic, shrink, assume an irregular shape, lose their chromatin and become fragmented. They then stain with eosin instead of hematoxylin and later are homogeneous and unstained. Large phagocytic cells filled with fat from the products of degeneration appear. Mucin has been demonstrated in cystic spaces by the use of thionine stain.

Bipolar cells with delicate processes representing spongioblasts as well as a few more adult astroblasts and astrocytes may be present in the tumor. The ganglion cells reported are probably normal cells in retinal layers being infiltrated by the tumor. The tendency being at least predominantly toward differentiation along the glia series, these tumors might thus be called retinoblastoma gliomatosum. Cattaneo [19] called these tumors retinomas, while Mawas termed them retinocystomas, both meaning the same type of neoplasm. However, I believe that the term retinoblastoma is more appropriate to the type and stage of differentiation of the neoplastic cells.

NEURO-EPITHELIOMAS

Since the first reports on neuro-epithelial tumors by Flexner and Wintersteiner, many such cases have been reported. Their chief characteristic is the formation of true rosettes, which may occur also in tumors of more primitive structure, such as the medullo-epitheliomas previously described as arising from the ciliary processes.

19. Cattaneo, D.: Istogenesi della neuroglia nelle vie ottiche del neuro, Arch. ital. di anat. e di embriol. **20**:371, 1923.

Fuchs,[20] in classifying tumors of the ciliary process, divided them into benign adenomas and malignant tumors. The benign tumors that he described were probably neuro-epitheliomas, which have a glandular appearance because of their rosettes. Associated with their more advanced position in the histogenetic series, these tumors are relatively less malignant. The same neuro-epithelial structures may appear in senile excrescences of the ciliary body and apparently have little tendency toward growth. Numerous typical rosettes have also been observed in intra-ocular infections involving the ciliary body. Furthermore, Wehrli,[21] Fuchs and others found rosettes pinched off from the retinal epithelium in microphthalmia associated with developmental defects of the brain. Wehrli expressed the belief that folding of the retinal epithelium and pinching off of rosettes takes place rather frequently and that birth-trauma and hemorrhages stimulate them into rapid malignant growth.

Fuchs' malignant tumors include those which completely imitate the embryologic retina (diktyoma), which are undoubtedly medullo-epitheliomas, and the less completely imitative tumors, probably retinoblastomas and neuro-epitheliomas.

Neuro-epitheliomas are in reality tumors composed of primitive spongioblasts. Of their occurrence in the brain only six authentic instances are known, the last ones being reported by Bucy and Muncie.[22] These are identical in type with those arising from the retina. Bucy and Muncie's article should be referred to for the authors' modified technic of impregnating the processes of the spongioblasts. Flexner,[2] Wintersteiner,[23] Pergens [24] and Pusey [25] gave excellent illustrations of these retinal tumors.

The neuro-epithelial retinal tumors arise in the external nuclear layer and are composed of cells of columnar type with an irregular contour and indistinctly staining cytoplasm. The nuclei are round or spherical, and stain sharply. The cells have a broad end which adjoins a circular cavity or rosette formed by the radiation of numerous cells about a central cavity or space that does not contain a blood vessel

20. Fuchs, E.: Wucherungen und Geschwülste des Ciliarepithels, Arch. f. Ophth. **68**:534, 1908.

21. Wehrli, E.: Ueber die Mikro- und Makrogyrie des Gehirns analoge Entwicklungsstörungen der Retina; mit Besprechung der Epithelrosetten und der Pathogenese des Glioms, Arch. f. Ophth. **60**:302, 1905.

22. Bucy, P., and Muncie, W.: Neuroepithelioma of the Cerebellum, Am. J. Path. **5**:157, 1929.

23. Wintersteiner, H.: Das Neuroepithelioma retinae, Vienna, Franz Deuticke, 1897.

24. Pergens, E.: Ueber Adenom des Ciliarkörpers als Ursache vom Glaukom, Arch. f. Augenh. **32**:293, 1896.

25. Pusey, B.: The Genesis of Glioma Retinae in Neuroglia, Bull. Johns Hopkins Hosp. **13**:229, 1902.

as do the pseudorosettes of the retinoblastomas (fig. 8). The cell membranes form the internal limiting membrane of the rosette. Colloid or hyaline material may be present in the cavity. Through the internal membrane projects a fine delicate short cilia-like process and from the outer pole of the cell there projects a fine indistinct tail-like process. The greatest part of the cytoplasm exists between the nucleus and the internal limiting membrane. No external membrane can be found. Mitotic figures are abundant.

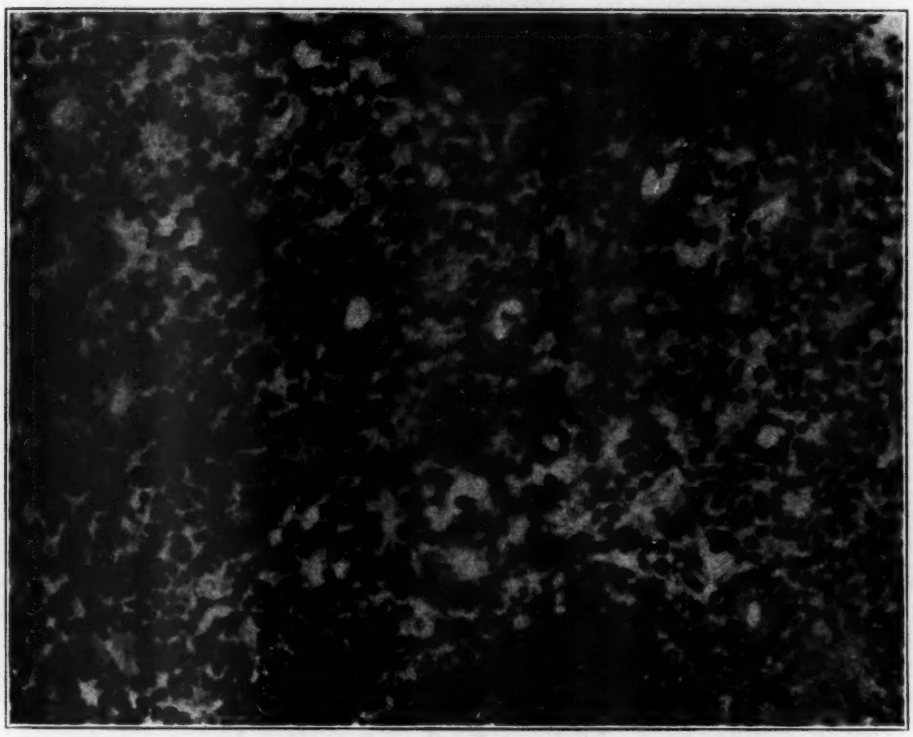

Fig. 8.—Neuro-epithelioma of the retina, showing the true rosettes. Hematoxylin and eosin; × 150.

Between the rosettes are many small round cells with scanty cytoplasm and dark-staining nuclei, apparently retinoblasts. Many elongated spongioblasts, their fine processes attached to blood vessels, also lie between the rosettes. Numerous newly formed blood vessels can be found. The walls of the larger blood vessels are thickened and hyalinized. There are many degenerated areas with poorly stained cells, and hemorrhages are frequent.

The close resemblance of the spongioblastic rosettes to normal rods and cones has been remarked on by every observer since Flexner. The cilia-like process penetrating the internal limiting membrane of the

rosette, the position of the nucleus within the cell and the tail-like process are comparable to corresponding portions of rod cell. There can be no doubt that the rods and cones form a sensory epithelium and are not ganglion cells. They are derived, on the contrary, from a portion of the retinal epithelium corresponding to the primitive spongioblasts of the brain. They exist in adult life in the form of primitive spongioblasts arranged as the layer of rods and cones. It is only in tumor formations that the arrangement about vacant spaces is found, but free spongioblasts are also observed. Bailey and Cushing correctly stated that these tumors might be called "spongioblastoma primitivum retinae."

It was difficult to obtain a retinal glioma suitable for study with modern staining methods because alcohol prevents the use of such methods. Finally, through the courtesy of Dr. D. T. Vail, Jr., of Cincinnati, a neuro-epithelioma of the retina in a dilute solution of formaldehyde (10 per cent) was received.

RESULTS OF STUDY

By means of hematoxylin and eosin stains the usual large areas of degeneration distal from the blood vessels were demonstrated (fig. 8). The persistence of cells in the immediate vicinity of the smaller vessels produced a picture of a pseudorosette, which frequently, as in Pusey's [25] drawings, is called a rosette. In the degenerated areas were scattered clumps of cells with dark-staining pyknotic nuclei. Many shadows of almost completely degenerated cells were visible. The vessels in the degenerated areas were extremely thickened with homogeneous-staining collagenous connective tissue. It is this vascular change which probably caused the degeneration of distally placed cells.

The cell structures assumed, for the most part, an arrangement which is termed rosette-like, although between the rosettes many identical cells were scattered in no special formation. The rosettes were arranged around small cavities which were not blood vessels; they were empty or contained débris. With phosphotungstic acid and hematoxylin stain the cells were seen to be small and oval or pear-shaped, larger at their margin away from the central lumen. It was at this base that the relatively large nucleus lay. On the inner surface of the cells a limiting membrane was formed which encircled the rosette. The external cell boundaries did not form a membrane but tapered off indefinitely into a short tail-like process. Occasionally in the cytoplasm beneath the inner limiting membrane were found one or two dark biscuit-shaped granules which resembled the blepharoplasts found in primitive ependymal cells. Their function was unknown but they may have had some connection with cilia formation. Some cells had a thin short cilia-like process which penetrated into the lumen of the rosette.

By means of a technic of silver impregnation a remarkable picture was disclosed (figs. 9 and 10). The walls of the blood vessels were heavily impregnated with silver, but multiple strands of fibers were seen which left the walls to form the processes of cells whose nuclei were situated a short distance from the walls. These perivascular or sucker feet arose from several types of glia as thick heavy processes.

One type was an astroblast, a cell somewhat more developed than the spongioblast but itself a precursor of astrocytes. The astroblast had a small rounded

body with considerable cytoplasm. From the cell arose one very thick process which ran to the blood vessels, where it was attached. This process was impregnated heavily, and frequently the cytoplasm of the cell was also very dark. In some cells there were one or two short processes which extended in other directions, or perhaps one longer process which had a thick protoplasmic connection with the body of the cell.

The astrocytes were farther from the wall of the vessel and had a thinner perivascular foot. Their cytoplasm was more heavily impregnated throughout. The cell body was larger and more angular. The nonvascular processes extended for a greater distance from the cell, were more numerous and had more branches. Both the astroblasts and astrocytes were arranged radially around the blood vessels.

Fig. 9.—Low power photomicrograph showing the relation of rosettes and impregnated cells. Kanzler impregnation; × 150. The cells and their processes can be seen with a hand lens.

Other cells attached to the blood vessels by a short thick process had an oval-shaped body and a single long tail-like process, which terminated either in another plane of the section or on the wall of another blood vessel. These were probably primitive spongioblasts, which in the retina not only give rise to the adult glia, but probably persist in modified form as rods and cones.

Scattered throughout the stroma were small rounded cells with scanty cytoplasm, a relatively large nucleus and few processes. These cells were less heavily impregnated. Their processes were short and had few branches; they were not attached to the walls of the blood vessel. These were probably oligodendroglia.

The details of their origin are not definitely known, but they are believed to be derived from the medullary epithelium at some stage in the histogenesis of neuroglia.

The majority of the cells were the pear-shaped cells of the rosettes and were usually not impregnated. Occasionally, however, a faint, thick, protoplasmic process was visible at one pole of the cell.

This tumor thus demonstrated that in the neuro-epitheliomas not only primitive spongioblasts but astroblasts and astrocytes are found.

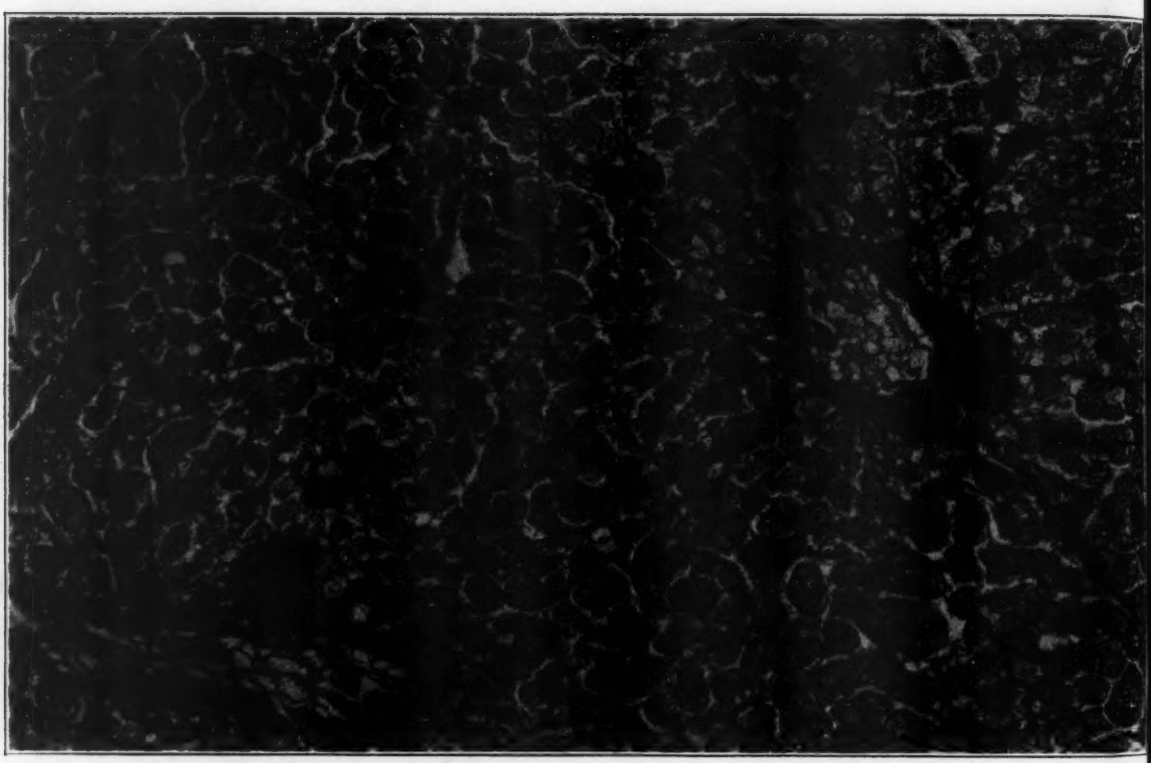

Fig. 10.—Drawing of a high power magnification of the same field as in figure 9: *b.v.*, blood vessel; *o*, oligodendroglia; *s*, primitive spongioblast; *r*, rosette; *ab*, astroblast, and *ac*, astrocyte.

The predominating cells are, of course, the spongioblasts or neuroepithelium; hence the name applied to these tumors is neuro-epithelioma.[26]

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26. Marchesani, O.: Untersuchung über die Glia: II. Das Glioma retinal, Arch. Auggenh. **103**:484, 1930. This work, seen after my article was submitted, reveals the same structures impregnated by silver methods in a neuro-epithelioma of the retina as I have described.

SUMMARY

The glial tumors of the retina are divisible into three large groups. The medullo-epitheliomas consist mostly of primitive retinal epithelium, which persists in adult life as ciliary epithelium and from which these tumors arise, and also of neuro-epithelium and retinoblasts. Retinoblastomas are chiefly composed of retinoblasts. In the tumors composed of these indifferent cells, evolutionary stages in the histogenesis of adult retinal glia have been found, but no cells of the ganglion series have as yet been described. In the neuro-epitheliomas, spongioblasts are found in rosette-like arrangement. These cells closely resemble the rods and cones. Primitive spongioblasts, astroblasts, astrocytes and oligodendroglia are also found, all normally derived from the neuro-epithelium. A histogenesis of glia possibly occurs in these tumors, but each group contains a preponderance of the more primitive types of cells. Tumors of pigmented epithelium have not been described, possibly because the epithelial cells lose their pigment in neoplasms.

A better understanding of retinal gliomas can be obtained by comparing the cells found in retinal tumors with stages in the histogenesis of normal retinal elements. The specific morphologic characteristics of the glia constituents of the gliomas can be obtained only by the use of proper methods of fixation, sectioning and silver impregnation.

MULTIPLE EPIDERMOID CARCINOMA OF EYE AND LID*

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AND
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James G., aged 20, was admitted to the eye clinic of Dr. E. S. Thomson in the Manhattan Eye, Ear and Throat Hospital on Jan. 30, 1928, complaining of a growth on the lower right eyelid which had been present for three months. It was increasing in size and slightly tender. The lesion was ulcerated and inflamed, and was 2 cm. long, 1 cm. wide and 0.5 cm. deep. Because of its inflammatory nature it was not thought to be malignant on first examination, and was treated for three days with local applications until the following biopsy report by Dr. Eggston, attending pathologist, was received: "Specimen consists of a small fragment of tissue, 8 by 5 by 4 mm. Section shows greatly proliferated stratified epithelium with marked papillary infiltration and penetration of the stroma. There are numerous mitotic cells and a few epithelial pearls present. Diagnosis: squamous cell epithelioma (malignant)." Dark-field transillumination was negative for spirochetes. The Wassermann reaction of the blood was one plus, and the Kahn test was negative.

The patient was referred to the radium department, and a total treatment of 400 mg. hours was administered over a period of three and a half months. Notes on progress made at the time of the treatments showed that the growth responded to radiotherapy immediately, and at the end of four months the growth had disappeared. It had been replaced by scar tissue, leaving a defect in the upper edge of the lower lid so that there was not quite perfect approximation of the lids.

The patient did not report to the clinic for the following twenty-six months. He returned on Aug. 30, 1930, with the complaint that for three months a growth had been present on the left eyeball. Examination of the left eye revealed, on the nasal side, a thickened ovoid mass of tissue simulating granulations, about the size of a dime, occupying the space from 9 to 12 o'clock of the limbus and extending slightly more over the conjunctiva than the cornea, but extending over the cornea to a point about halfway between the corneal limbus and its center. There was slight injection of the vessels around the mass. There was no pain, and the only feeling was that occasioned by physical displacement. There was no discharge. Examination of the other eye revealed that the lower lid, which had been treated two years previously, appeared to be free from disease. The lid was soft and smooth, and only a slight defect remained at the site of the original growth. But on the conjunctiva of the right eye opposite the defect, in the area thus exposed, there had developed a small papillomatous growth of conjunctiva, the area surrounding which was slightly injected. In addition, a small pterygium was beginning to appear on the nasal side of the globe, approaching but not encroaching on the cornea. Vision was 20/20-1 in the right eye and 20/40 in the left, with no complaint of impairment.

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* Read before the Section on Ophthalmology, New York Academy of Medicine, Dec. 15, 1930.

Because of the size of the mass on the left eye and its sharp line of demarcation from the surrounding tissue, the growth was easily dissected away. The feel of the knife on separating it from the cornea was about the same as that usually transmitted to the knife when one removes the head of a pterygium. The mass was fibrous and firmly adherent to the cornea, but was separated without much difficulty. The conjunctiva was closed with three plain black silk sutures. The small mass of papillomatous tissue on the conjunctiva of the right eye already described was also removed. One suture closed the wound. The laboratory reported: "The specimen consists of two masses of tissue, the larger 9 by 3 mm. from the left eye, and the smaller 2 mm. from the right eye. The larger mass consists of an excessive and irregular hyperplastic squamous epithelium with active mitotic cells and some pearl formation. The tissue is rather vascular with very little stroma present. The smaller mass shows some squamous epithelium with one area of excessive cellular proliferation, but no active mitosis or infiltration is evident. The cells are similar in nature to those of the larger mass but do not appear quite so young and active. Diagnosis: squamous cell epithelioma of the left eye; with papilloma of the right eye showing some signs of epitheliomatous changes." The Wassermann and Kahn tests of the blood were negative.

A B

Fig. 1.—*A*, squamous cell carcinoma of the right lower lid before treatment. *B*, healed lesion three years after radium therapy. The tumor of the left corneal limbus has been removed.

The patient remained under observation, and radiotherapy was begun immediately after healing of the wounds occasioned by dissection of the masses from each eye. At the present writing, three months later, there is no evidence of a growth in either eye or lid and no conjunctivitis, pain or discharge. Vision remains 20/20-1 in the right eye and 20/40 in the left, without discomfort. At all times the fundi have appeared normal. The patient is now, as before, in good physical condition, continuing his occupation as a laborer. There has been no loss of weight. There are no glandular enlargements and no evidence of tumor elsewhere.

Because of the patient's age, the nature and multiplicity of the tumors, their peculiar locations and their sustained response to the treatment instituted, we think this case worthy of report. Multiple primary malignant growths of one organ are not common, and multiple

Fig. 2.—Papilloma of the right conjunctiva (low power).

primary growths involving two or more unrelated organs are comparatively rare. Incidentally, this case also shows that arbitrary age limits for certain types of tumors are flexible, becoming more so with an increased number of case reports and additional knowledge of tumors and malignant processes.

One review of autopsies reported recently (Angevin[1]) reveals that in 13,090 autopsies only 113 instances (0.86 per cent) of multiple primary neoplasms were noted. The tabulators were not primarily interested in the eye, though the eye was not excluded from their

Fig. 3.—Squamous cell carcinoma of the left corneal limbus (low power).

observations. However, I found no report of multiple epithelioid tumors involving the eyeball and the opposite lids. Contact tumors involving the lid and globe have been noted.

1. Angevin, D. M.: Canad. M. A. J. **23**:38 (July) 1930.

No authority seems to venture a positive and satisfactory explanation of why multiple primary malignant growths occur, but various writers grant that their occurrence denotes some (vague) predisposition on the part of the person thus affected. Wells [2] and Ewing [3] dismissed

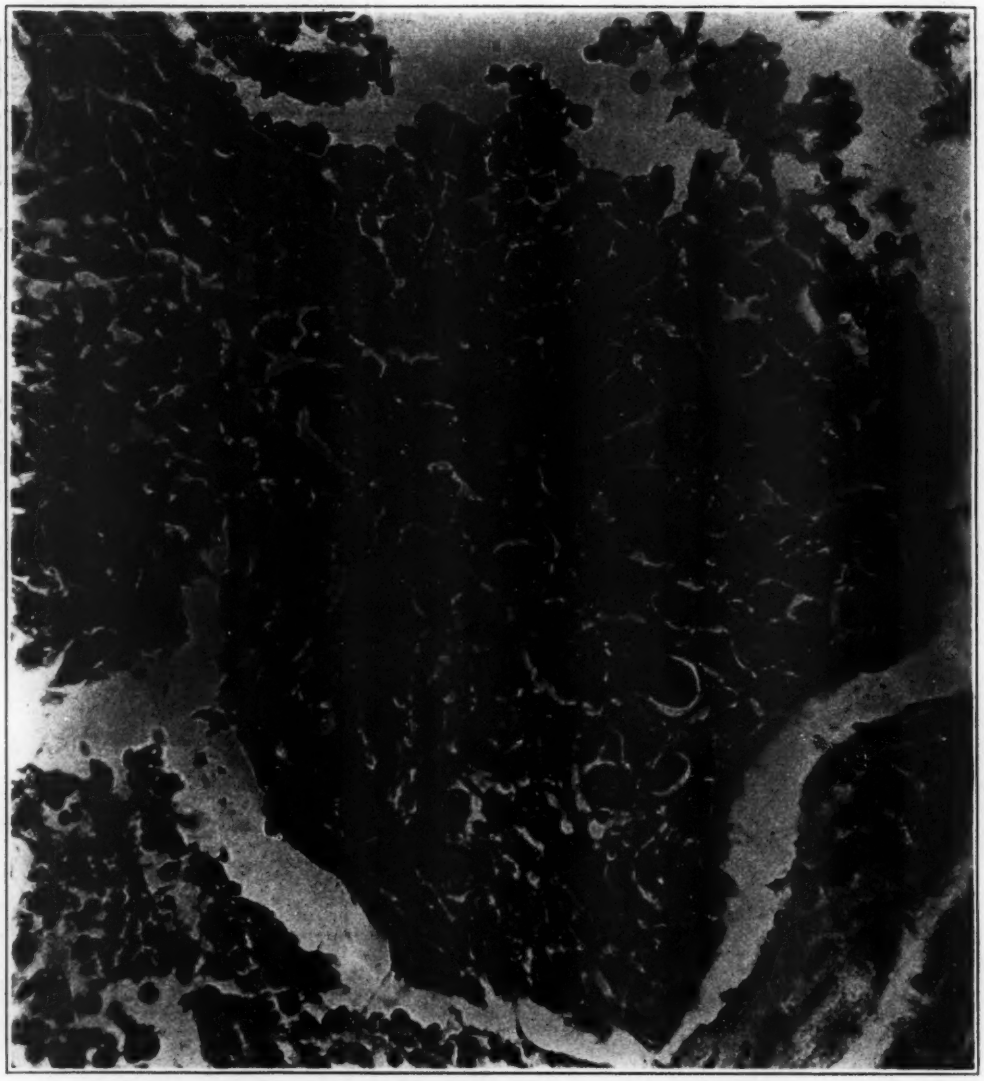

Fig. 4.—Squamous cell carcinoma of the left corneal limbus (high power).

the question by stating that the occurrence is a coincidence. Earlier writers considered multiple tumors to be a systemic disease, but Major,[4]

2. Wells, H. G.: J. Path. & Bact. **7**:357, 1901.

3. Ewing, James: Neoplastic Diseases, ed. 3, Philadelphia, W. B. Saunders Company, 1928.

4. Major, quoted by Angevin (footnote 1).

in a large series of cases, observed that "disregarding the skin, multiple tumors do not have a predilection for organs of the same system, except for paired organs, which is in contrast to the predilection for single growths." He observed that "malignant growths, again disregarding the skin, were more common in unrelated organs." In regard to an individual predisposition to multiple malignant growths, Williams [5] concluded that "initial multiplicity is relatively often concomitant with certain structural derangements, which may be assumed to give predisposition thereto. These derangements comprise prenatal developmental irregularities, especially obvious in early life. Taken in their entirety these various considerations point to some general systemic change as the predisposing cause of primary multiplicity." Bartlett [6] considered the occurrence of primary malignant tumors in paired organs too frequent and consistent to be considered incidental, and the cases that he reviewed seemed to indicate that a certain type of tissue may be predisposed to malignant transformation under favorable circumstances of irritation. Tumors occurring bilaterally in the same system he considered indicative of predisposition of the tissues, dependent on an anomalous embryonal development. However, other cases, distributed miscellaneously, have no common features.

The predilection of malignant neoplasms for development in areas of tissue transition, as where the epithelium of the skin passes into that of the mucous membrane, is so well recognized that it needs no further elucidation.

Epithelioma of the limbus is one of the most common neoplasms of the eye. It is usually primary, situated nasally or temporally, but may appear secondary to epithelioma of the lids. Usually a single nodule appears on the conjunctival side of the limbus, and then extends up and down along the limbus, spreading over both the cornea and the conjunctiva. It seems to occur more frequently in men than in women, so that it may be surmised that exposure and trauma play a part in the progress of the growth, as well as in its location. A pterygium may be the site of an epithelioma, but the presence of a pterygium does not necessarily predispose the tissue to the development of an epithelioma. In a report and review of epitheliomas from the Mayo Clinic, no case of primary epithelioma of the limbus was observed in a female patient, and few cases were found in men less than 40 years of age. The individual ages of the patients in the ten cases cited

5. Williams, W. R.: Natural History of Cancer, London, W. Heineman, 1908.

6. Bartlett, F. K.: Multiple Primary Malignant Tumors, Arch. Int. Med. **13**:624 (April) 1914.

were 59, 58, 43, 36, 48, 72, 37, 40 and 50. It was stated that multiple epitheliomas of the limbus do not often occur. Extension of the growth is usually along the surface of the globe, rarely penetrating inside the limbus, though it may do so (Dr. Ben Witt Key [7]) by advancing along the internal sulcus on the corneoscleral border, obstructing Schlemm's canal, and invading the ciliary body and perichoroidal space through the corneoscleral stroma; or, less frequently, it may advance along the ciliary vessels as they pass through the sclera to the ciliary body; or it may invade the substance of the cornea to Descemet's membrane, thence to Schlemm's canal, the ciliary body and the perichoroid.

Primary epithelioma of the lids is more frequently of the basal cell type, with low grade malignancy. The squamous cell type does occur, as is illustrated by the case described.

In the Mayo Clinic report [8] it was concluded that these malignant processes are accelerated by irritants such as iodine, phenol, zinc chloride and small doses of radium, that excision is of little help, and that fulguration is the best way to remove epitheliomas of the limbus with safety.

Neglected cases of epithelomas of the lids or of the limbus eventually necessitate orbital exenteration and frequently cause death from metastases.

7. Key, Ben Witt: Tr. Am. Ophth. Soc. **27**:41, 1929.
8. Benedict, W. L.: S. Clin. North America **9**:813 (Aug.) 1929.

THE POSTCYCLOPLEGIC TEST*

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The postcycloplegic test is one to be considered distinctly as a supplement to refraction carried out under cycloplegia, and is commonly grossly abused by the free-hand mutilation that it suffers in the hands of the careless refractionist. The value of results obtained in the test depend largely on the reliance that may be placed on the figures obtained under cycloplegia. It will be assumed, therefore, that the test is based on numerical determinations obtained by painstaking retinoscopy and a careful check-up with the trial case. The elements of uncertainty that may affect the accuracy of figures in these fundamental tests are too well known to be cited in this connection, and the refractionist must be the judge of how far subjective influences have affected objective data. It will be taken for granted, however, that a drug is used that will yield fairly consistent figures in the retinoscopy and the test with the trial case. The period elapsing after the last drop of the drug is administered is that usually accepted for such work.

The first step in any postcycloplegic test is to determine the vision of each eye with the correction found under drops—the "full" correction. In some cases this is the same or nearly the same as that obtained under cycloplegia. In such cases the patient is said to accept the full correction, and further information is unnecessary. In most cases, however, particularly in hyperopic subjects, vision with correction is found to be considerably poorer than that obtained under cycloplegia. The same is less true in cases in which a high cylinder has improved vision and still less true in myopia. The reason for this seems well established, namely, the return of tonus in the ciliary muscle after the effect of the paralyzing drug has worn off; it is the best explanation of so-called latent hyperopia.

The problem is now to decide whether glasses are to be ordered for the patient, and if so, what strength is needed. The refractionist is in possession of a set of figures that he may regard as representing the static error of refraction, and he is confronted by the fact that the patient no longer sees as well with the basic correction as when it was determined. Since it is not unlikely that the patient will object strenuously to wearing glasses that not only do not improve his distant vision but actually blur it (excluding presbyopia), it is necessary to alter the

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original correction before ordering the glasses or to forestall the patient's objections should the full correction be the only one deemed adequate to relieve the symptoms. The first of these two alternatives involves a process usually of reducing ("cutting") the strength of convex lenses and, occasionally, of increasing the strength of the concave elements, and it is in the application of this process, so often imperfectly understood, that widespread confusion prevails. It is no uncommon thing to see a well grounded atropine or homatropine hydrobromide refraction thus degenerate into a mere manifest. The actual procedure, e. g., in the case of compound hyperopic astigmatism, may be as follows: Starting with the full correction before each eye separately, one gradually reduces the sphere until the vision obtained equals that obtained under cycloplegia. The amount of reduction necessary may be arrived at roughly by placing minus spheres in gradually increasing strength of plus sphere before the eye wearing full correction, and finally putting the reduced correction in the trial-frame. In the case of high values of sphere (disregarding the cylinder for the moment) a very large reduction may be necessary before clearest vision is obtained, especially in persons who have previously worn no glasses or perhaps a very incomplete correction. Thus one-half, three-quarters or even all of the sphere may have to be "cut"; cases are not unheard of in which a small value of negative sphere must be substituted for the positive to obtain the vision of the basic refraction. The following is a concrete example: A refraction performed under atropine yields the figures: right eye, + 2.50 with + 1.25 cylinder axis 90 = 1.2; left eye, + 3.00 with + 1.00 cylinder axis 105 = 1.5-4(form A); the postcycloplegic test with this correction gives 0.3 + 1 in the right eye and 0.3 in the left. In reducing the strength of the spheres, one must weaken the right by 2 diopters, and the left by 2.5 diopters to bring the vision to the value stated, leaving: right eye, + .50 with + 1.25 cylinder axis 90; left eye, + .50 with + 1.00 cylinder axis 105 (form B).

The patient should now accept the glass for distant as well as for near vision. Whether one should order this reduced correction, the full correction or one intermediate in strength is a question that must be answered only after a consideration of a number of conditions, among which the following seem of prime importance: 1. What symptoms are complained of: (*a*) poor vision for distance; (*b*) blurring or tiring, etc., on the use of the eyes for near vision; (*c*) headaches related to the use of the eyes for near vision? (The latter two symptoms are of the type usually classed under asthenopia.) 2. Are glasses being worn? If so, are they similar to the present correction, and to what extent are symptoms relieved by them? 3. Is the unaided vision for distance adequate for ordinary affairs? 4. Is the patient's work such as to make the wearing of glasses which "blur" at 20 feet

(6 meters) out of the question? Other questions will doubtless occur to the experienced refractionist, but it will be possible in the average case to write a rational prescription with no more than the foregoing information at hand.

In considering the same hypothetic case, let it be assumed that the patient is a young adult doing clerical work in an office. He has never worn glasses, and he has no difficulty with his work. He has noticed, however, for a year or more, that it is hard for him to read small print and subtitles on the cinema screen, and he has occasionally had some difficulty in recognizing his acquaintances across the street. Obviously, the correction giving clearest distance vision is the one to order, namely, right eye, + .50 with + 1.25 cylinder axis 90; left eye, + .50 with + 1.00 cylinder axis 105, or even the cylinders alone. If the patient complains of a tiring of the eyes on near use, together with smarting, tearing, etc., this mild asthenopia will probably be relieved by the same correction.

It is now assumed that he has worn a similar correction with relief for a time, but the symptoms have reappeared. The refractionist is called on to provide a more complete correction, without diminishing visual acuity if possible.

My method of determining this correction is based on the principle, not too well known among medical refractionists, that in the average hyperopic person more latent hyperopia will become mainfest in testing both eyes together than in testing either eye alone. Accordingly, a lens with the preceding (reduced) correction is placed in the trial-frame, and the patient is allowed to use both eyes; plus spheres of equal and gradually increasing strength are added. The plus .25 and .50 spheres or stronger lenses are successively exhibited (allowing a moment for relaxation of the accommodation), and the patient is instructed to fix the smallest test type that he can read easily and to indicate when it begins to look blurred. It is not unusual to find by this process that from one-half to 1 diopter can be added without blur—even the full correction may be accepted.

It is now supposed that the patient sees as well binocularly with + .50 added to the correction as determined for each eye singly. One then has: right eye, + 1.00 with + 1.25 cylinder axis 90; left eye, + 1.00 with + 1.00 cylinder axis 105 (form C), and can order glasses with this correction in the assurance that the symptoms will be relieved for a considerable period and that the patient will not be forced to look over the top of his glasses to see distant objects clearly. (Overcorrection of a patient's manifest hyperopia is often far more uncomfortable than undercorrection or none at all.) Here again, however, one must compare the correction just obtained with that being worn by the patient; if, as before, the two are similar, it is probable that even

stronger lenses will be needed. When such is the case one is no longer able to relieve asthenopia (excluding that due to muscular imbalance) by glasses giving clear vision at a distance and one must resort to other expedients, such as (1) prescribing the full strength of spherocylinder as determined under cycloplegia, these glasses to be worn for close work only, (*a*) no glasses to be used when clear vision for distance is requisite, or (*b*) a second pair providing an incomplete correction to be worn for clear vision at the theater or movies, and in driving, sports, etc.; (2) prescribing bifocals that represent a combination of 1 *b*, a practice to be avoided.

The sole purpose of the postcycloplegic test is to determine the relation between manifest and total hyperopia, the knowledge of which is of great value to the refractionist. It should be assumed for practical purposes that the return of ciliary tonus takes place evenly in all parts of the ciliary muscle. This means that 1 diopter of astigmatism at a given axis, found under cycloplegia, will be present at the same axis when accommodation has returned, regardless of what portion of the spherical correction the patient accepts. Thus, + 3.00 with + 1.00 cylinder axis 90 may become + 1.00 cylinder alone, or even — .50 with + 1.00 cylinder axis 90, a negative value of sphere replacing the positive to secure full visual acuity.

Mutilation occurs when the final correction, instead of taking the form of B or C, assumes the following form: right eye, + .50 with + 1.00 cylinder axis 90; left eye, + .75 with + 1.25 cylinder axis 95; in this, the strength of both cylinders, as well as the axis of the left, has been altered. This radical alteration may be justifiable, particularly in an unusually intelligent and cooperative patient, but usually it must be assumed that: (1) there was an error in the determination of values under cycloplegia; (2) an extrapupillary portion of the cornea (or lens) was in play during the cycloplegic test, owing to the mydriasis; (3) an irregular action of the ciliary muscle has changed the value or axis of the total (lenticular and corneal) astigmatism or both, or (4) the stenopeic effect of the lids has altered the value of the astigmatism. In any case, the examiner who changes the fundamental character of his correction as a result of his postcycloplegic test must assume the burden of proof that his final correction is the one to be ordered for the patient rather than one which adheres more rigidly to the original form. Attempts to simulate the normal pupil during the cycloplegic test by placing diaphragms with small apertures before the eye are efforts in the right direction, but little confidence should be placed in this device since the aperture is as apt to lie over an eccentric part of the dilated pupil as over its center.

The application of the postcycloplegic test to myopic persons involves considerations somewhat different from those involved in refraction of

hyperopic persons. The manifestations of ciliary tonus or hypertonus are rarely of prominence or importance in the myopic patient, and changes in the basic correction are usually of distinctly minor character. Cycloplegia is usually easier to produce and more complete in myopia than in hyperopia, and the figures obtained in the basic test are correspondingly more exact. Marked alterations during the postcycloplegic test should be entertained only on the most careful subjective check-up in which the patient consistently accepts spherical or astigmatic correction at variance with the original. The ancient practice of undercorrecting the spherical part of myopic corrections "on general principles" is to be condemned, particularly in young persons, unless it can be conclusively shown that the patient is unable to accommodate himself to the complete correction of the myopia.

The state of balance of the external muscles should always be kept in mind by the refractionist and will often influence him in his choice of a final correction of the refractive error, even though he does not resort to the introduction of prismatic strength into the glasses. While I shall not discuss this complex department of refraction, I should like to point out that heterophorias of a "regular" character, that is, esophoria with hyperopia and exophoria with myopia, call for less consideration than those in reverse association (exophoria coupled with hyperopia, etc.). The latter sometimes presents great difficulties to the refractionist.

I have intended this paper to serve as a guide for less experienced students of refraction who feel the need of a practical working plan in fitting glasses to a large and important group of patients.

Ophthalmologic Review

PROGRESS IN MEDICAL AND IN SURGICAL TREATMENT IN OPHTHALMOLOGY

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The observations offered here are meant to be an orderly arrangement of topic material gleaned from literature that has appeared in English, originally or by abstracts, during the last twelve months.

DETACHMENT OF THE RETINA

Knapp [1] stated that the remarkable results in retinal detachment obtained by Gonin would lead to a renewed interest and study of the whole subject. Of the titles considered for this report, 42 per cent pertained to some phase of detachment of the retina. Gonin's operation is not readily comprehensible without a methodical presentation of the subject for which it was devised.

Detachment of the retina is considered to be spontaneous or traumatic in origin. Spontaneous cases occur without known injury. Traumatic cases arise from mechanical factors such as progressive myopia,[2] perforating wounds or contusions of the globe, blows on the head, concussion of the body and physical strain.[3] When the etiology is analyzed, some contributing or predisposing factors are necessary, and the principal one is some derangement of the body or of the eye itself.[3]

Progressive myopia has the reputation of predisposing the retina to detachment.[2] The sclera and choroid undergo stretching; the retina cannot be stretched, hence it must either be torn or become detached. Detachment is more probable in spherical distention than in posterior staphyloma or in regional ectasiae.[4]

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MacCallan [5] and Thompson [6] have each reported cases of bilateral detachments in eyes with 8 and 9 diopters of hyperopia, but the descriptions of the affected eyes were incomplete.

Perforations of the eyeball predispose to detachment, and contusions of the globe in exceptional cases lead to it.[3] The importance of the history of the case, both before and after injury,[7] must be emphasized. In a series of 6,474 ocular injuries there occurred 69 cases of detachment of the retina; 11 of these were due to perforating wounds, and of the remaining 58 patients, 38 alleged blows on the eye.[8]

Concussions of the head or body do not cause separation of the retina unless the eye is already diseased. Physical strains should not be considered unless there is an onset of visual disturbance within three days or unless the detachment appears within eight days after the strain.[3]

Other etiologic factors are ocular inflammations with exudates, congenital conditions mainly exhibited as structural weaknesses, parasites, pregnancy and idiopathy.[2]

Gonin's operation deals with the sealing of rents, tears or holes in the retina to the choroid. It is of importance to understand how these lesions may be produced.

The combined mechanical and diffusion theory assumes a low tension in front of the retina or in the vitreous chamber, and a higher tension behind the retina or in the retroretinal space.[2] The physicochemical qualities of the vitreous [9] are significant. The fluids in the vitreous chamber contain crystalloids which pass through the retina to the retroretinal space, while the fluids in the tissue spaces and lymphatics of the choroid contain colloids which do not pass through the retina to the vitreous.[2]

Diffusion occurs by dialysis. Under some circumstances the solids in the fluids of the retroretinal space become concentrated and the tension rises there, while the solids in the fluids of the vitreous chamber become diluted and there the tension falls.[2] There is a difference in pressure in the vitreous and retroretinal spaces.[9] The loss of crystalloids in the fluids of the vitreous chamber may cause adhesions of the vitreous to the retina and shrinkage of the vitreous body.[2] Contraction and the resulting traction, together with other factors, lead to detachment of the retina with or without tears.

A decline in the capillary pressure in the retinal vessels, or an increase in the capillary pressure in the choroidal vessels, can cause detachment.[9] A relationship exists between detachment of the retina and general and local disturbances in the capillaries. Increased tension in an eye with detachment means that a local disturbance of the capillaries exists.[10]

After the therapeutic administration of insulin there occurs a hypoglycemia with a greater amount of exudate or transudate into the subretinal space from the choroidal plexus of vessels and a flat detachment.[11] Ocular hypotony favors a dilatation of the choroidal vessels with a transudation of fluid and a consequent detachment.[12] Capillary changes were present in 25 per cent of cases.[10]

An increased permeability of the walls of the choroidal vessels, with transudates and hemorrhages, and a greater fluidity of the vitreous exist in eyes affected with detachment.[13] Inflammatory and circulatory exudates,[14] with perivasculitis and edema,[15] also occur. In the detachment of pregnancy it is likely that the choriocapillaris produces a serum identical with that which obtains in general anasarca;[15] this may help to explain why this kind of detachment is subject to spontaneous cure.

The walls of the choroidal capillaries may become permeable to proteins, so that colloidal osmotic pressure behind the retina is greater than in front of it.[9] Salit[16] said that the water-absorbing ability or turgescence of a protein depends on the hydrogen-ion concentration of the aqueous medium surrounding it. By plotting a swelling curve of a protein under different hydrogen-ion concentrations, one finds that there are minimum and maximum swellings or smallest and greatest volumes occupied by the protein.

Experiments on animal eyes show that hydrogen-ion concentration and carbon dioxide content decrease with age. An increased choroidal capillary permeability, to the extent of passing large quantities of proteins into the subretinal space, will increase the bulk of subretinal fluids[17] and so predispose to detaching of the retina.

The actual rôle of the vitreous is in dispute. Vogt[18] listed among the causes the presence of a preretinitis with the formation of a detaching membrane. He referred to embryologic vitreous bases attached to the retina, which under certain circumstances may pull the retina into the vitreous chamber; he also mentioned disease of the vitreous as a predisposing factor.

Deutschmann[13] said that fluid vitreous predisposes to retinal detachment. Aschner[19] emphasized degeneration and liquefaction of the vitreous. Pascheff[14] alluded to this in connection with the production of holes in the retina. Baurmann[9] said that the vitreous is passive.

Predisposing diseases of the eye include small peripheral foci of choroiditis[14] and chorioretinal lesions.[20] In many cases of axial myopia the changes in the tissue are similar to those found in old age and consist of degenerations without demonstrable inflammatory processes; cystoid degeneration of the retina occurs in the equatorial zone and in the Blessig's spaces at the ora serrata.[18]

Vogt [21] noted fragments of retina adhering to a contracted vitreous, and asserted that a diseased, abnormally mobile vitreous might drag the retina loose, because the edges of a retinal tear are always curled inward toward the vitreous; he expressed the belief that spontaneous detachment is the direct result of a tear. Aschner [19] said that tears are due to retinal degeneration. Gradle [22] has biochemical support for stating that tears are due to a lytic action by accumulated, stagnant, subretinal fluid.

The shape of the protrusion of the retina into the vitreous chamber is consistent with pressure from the presence of transudates, exudates or hemorrhages in the retroretinal space rather than with traction by the vitreous; the holes are secondary to the detachment and are important because they prevent reattachment.[9]

A fine dust is usually found in the vitreous in the presence of retinal tears; Sourdille [23] said that it appears early and is transitory. The slit-lamp shows in all cases of spontaneous detachment numerous brown retinal pigment granules free in the vitreous.[24]

Syracuse [25] studied the histologic changes systematically at various periods after instituting experiments. He found that following cautery puncture of the upper pole of the sclera the retina became detached.

The episclera became infiltrated and edematous, and the choroid was enormously congested and thickened for two weeks. Abundant transudates formed at once under the retina and in the intraretinal space, which is the potential space between the neural layers and the pigment layer of the retina. The transudates coalesced and ruptured through the layer of pigment into the retroretinal space and then gravitated into the lower part of the eye where they remained for more than a year. While the retroretinal fluid was gravitating downward, the retina became reattached above where the experimental puncture had been made.

Within two weeks from the beginning of the experiment the layers of the retina became less distinct, under the microscope, because of atrophy and the processes of reattachment. Accumulations of proliferated retinal pigment infiltrated all coats of the eye, and the coats became closely adherent together in a firm cicatricial union.

The outer layers of the retina are nourished by osmosis from the choroidal capillaries.[17] Any disturbance in the process may produce changes in the cells and tissue of the affected layers, because fluid can penetrate into and among them.[26] Tears, rents or holes in the retina, whether early or late, single or multiple, mean retinal degeneration.[23] There may be tears without detachments and detachments without tears.[14] Fluid can pass in or out through a tear.[27]

Detached vitreous is frequently a prodromal sign of detachment of the retina.[28] Choroiditis may produce adhesions between the choroid and retina, and a fibrillation of the vitreous.[29] The combination may cause a tear in the retina; tears have occurred also from choroidal adhesions in myopic detachments.[30]

Redslob[31] said that soon after a detachment occurs the rods and cones disappear and the internal and external granular layers become unrecognizable, but that the ganglion cells resist the longest; the retina thickens by foldings or by proliferations of neuroglia. Hemorrhages are occasional precursors of detachment and tears,[20] but vitreous bands are not usually found in early cases.[25]

Spontaneous detachment occurs in acute gout[32] and in pregnancy,[22] but tears are rarely found; these cases usually heal spontaneously. Detachments with tears and those without tears are not in the same class.[33]

Hamilton[34] classified holes into three types: (1) those at the ora serrata, which are indicated by a white, folded, posterior edge in contrast with the lesser white of the detachment; (2) small round holes, usually from choroiditis and located from 1 to 1½ disk diameters from the ora serrata, and (3) horseshoe-shaped holes, caused by trauma.

Deutschmann[13] said that perforations occur above and may heal spontaneously, while tears occur below, and that tears near the ora serrata are from trauma. Thompson[27] believed that tears were present in about one third of the cases. Gonin[20] declared that holes were present in 90 per cent of cases, and probably in all if only they could be located. The patient may be put to bed prone for a few days, with or without aspiration of the subretinal fluid, and examined at intervals for a hole of the retina.[35]

The objects of treatment are to regain contact between the choroid and retina and to restore function.[2] Among the nonsurgical measures are the injection of iodized oil,[36] prolonged rest in bed, dehydration and the injection of hypertonic salt solutions into Tenon's space; these are intended to increase absorption and to promote the excretory functions.[2] Actual cures must come from resorption and cicatrization.[14]

Conservative writers point out that cases of spontaneous detachment, such as those due to localized inflammations,[33] to the renal retinitis of pregnancy[22] or to gout,[32] frequently show spontaneous reattachment.[33] In such cases one must also treat the patient for the coexisting choroiditis.[37] One patient showing a large myopic detachment with a tear was treated successfully by rest in bed and subconjunctival injections of physiologic solution of sodium chloride; at the end of one year the retina was still attached and no hole could be found.[38]

Various surgical expedients have been tried or proposed. One patient recovered after venesection.[19] Stallard [2] mentioned the horsehair or gold wire seton and the scleral trephine, but said that scleral puncture and drainage gave the best results. Thompson [27] favored the trephine combined with aspiration.

The indications for Gonin's ignipuncture are both general and local. Gonin [20] stated that the more recent the detachment and the younger the patient the better the prognosis. Deutschmann,[13] who claims twenty-five years of experience, said that this operation is indicated only where the tear is recent, accessible and of favorable size.

Vogt [18] regarded the inflammatory type of detachment as the most favorable. Thompson [27] thought detachments with holes the most intractable kind. Stallard [2] emphasized early treatment, but thought that conservative measures should be employed for two or three weeks before resorting to surgery. Meller [30] considered Gonin's ignipuncture superior to conservative treatment in myopic detachment with holes, but not when they were in the macular region.

In ignipuncture one may disregard vitreous dust,[23] but not profound disease of the vitreous or choroid or recent perforating injuries of the globe.[2] This procedure is not applicable to all types.[30]

Accurate localization of the tear is necessary.[39] It is important to know what part of the visual field was first affected.[34] The pupil should be widely dilated [34] and the eyeground explored by indirect [22] or direct ophthalmoscopy, with either ordinary or red-free [18] light. One must search for and exclude atrophic areas in the fundus.[34]

Goalwin [40] found that in locating a hole in the anterior part of the fundus the refractive displacement might be as much as 6 mm. in the anteroposterior direction. He recommended that the position of the hole should be located from the margin of the pupil on one side and then from the margin on the opposite side; the two readings are each to be projected onto the surface of the globe.

Amsler [41] contrived an apparatus with a stylet to mark the location of the tear. The perimeter arm and the ophthalmoscope can be used for localization.[42] Markings may be made with india ink [43] or by nicking the cornea at each end of the vertical and horizontal meridians and then staining the abrasions with fluorescein.[44]

Gradle [22] made a dot on the end of the corneal meridian that corresponded to the position of the rent, and another on the opposite end of the same meridian. He connected the two dots by a line and projected it backward 8 mm., on the surface of the globe, to the ora serrata. A thread may be laid across the two dots, 180 degrees apart, and extended backward beyond the ciliary body.[43] From the ora

serrata the tear can be located by computing the number of disk diameters at 1.5 mm. each.[22] Gradle operated with the tear under ophthalmoscopic observation.

A hidden tear may be revealed by making pressure over the ora serrata.[18] The subretinal fluid may be evacuated for the same purpose,[22] but a tear, once located, can become displaced and hidden after the fluid has been withdrawn.[45]

The most favorable time to operate by Gonin's method, according to Gradle,[22] is from the tenth to the twenty-first day after the detachment occurs. According to Meller it is from one day to one month.[31] Badeaux [46] said that this operation was indicated at any time under three months, provided a hole was found.

The object of ignipuncture is to seal the edges of the retinal tear to the underlying choroid and to hold them there by cicatrization or by the inflammatory reaction that seals the retina and choroid together.[33]

The effects were studied experimentally on rabbits' eyes by Herzfeld.[47] At the point of puncture the retina is firmly attached to the choroid. A striated puckered appearance is found in the retinal part of the scar. A massing of uveal pigment occurs at the point of puncture. He found no microscopic change in the retina, except an infiltration of round cells, but a local necrosis of the sclera. Ignipuncture, besides sealing the tissues together, probably does something that has not yet been determined.[23]

The conjunctiva must be dissected back to expose the sclera over the spot selected for puncture. Any extra-ocular muscle in the way, or needed for fixation, may be detached temporarily from its scleral insertion.[43] The subretinal fluid is drained off or aspirated.[29]

The actual cautery, thermocautery and electric cautery each have their advocates. The depth of the puncture is made according to the choice of the operator. Rubbrecht [48] asserted that the retina can be attached to the choroid without entering the vitreous; Amsler [28] noted that the cautery point should, but does not always, reach or touch the detached and retracted vitreous.

The degree of heat and the duration of contact with the tissues vary. Meller [45] made instantaneous punctures with the white-hot cautery because the resulting scar was small, white and flat. Lindner [49] used the red-hot cautery in contact for from ten to fifteen or even twenty seconds. Schoenberg [33] said that the degree of heat and the depth of the puncture made no difference, because the vitreous showed experimentally no effects from heat, and only a very small area of the retina showed any effects from it.

According to Waldstein,[50] Meller did not try to include the edge of the tear because he feared puckering and consequent redetachment, while Lindner regarded the searing of the tear as very important.

Rubbrecht [51] located the meridian, incised first the sclera and then the choroid to evacuate the subretinal fluid, and cauterized both edges of the tear for a distance of from 5 to 6 mm. The inflammatory reaction extended beyond the boundaries of the rupture and made a broad and solid adhesion.

In late cases and when Gonin's operation did not seem to be indicated, Sourdille [23] made a puncture in the upper temporal quadrant, where the detachment probably originated, and then cauterized the hole below. He said [26] that ignipuncture might produce bands in the vitreous.

Meller [30] advised that these operations be done in an ophthalmic institution where adequate facilities are available.

The postoperative treatment is important. The patient is put to bed, lying on the operated side, for from four to ten days [22] with absolute rest. Both eyes are bandaged. Hypertonic salt solution or a solution of cyanide of mercury [46] may be given subconjunctivally. The patient may be given methenamine, potassium iodide, sodium salicylate or salines.[52]

An examination may be made on the third day and daily thereafter. Postoperative recurrences are not uncommon.[14] Multiple tears are complicating.[18] The detachment may reappear above the tear after an operation below it.[20] The procedure may be repeated a week or two later.[2]

Gonin [20] reported 300 operations on 240 patients; postoperative hemorrhage occurred, after six or seven days, in 12, glaucoma in 2 and orbital cellulitis in 1. Meller [45] said that a postoperative hemorrhage helped to close and seal the tear, but that late hemorrhages were damaging.

When repeated operations fail, "colmatage" (subconjunctival cauterization of the sclerotic in two stages) or Sourdille's puncture may be attempted.[35]

Knapp [1] thought that ignipuncture produced, in the subretinal fluid, a coagulation of albumin which apparently organizes, contracts and attaches the retina to the choroid, but which may have a necrosing effect on the retina. Thompson [27] said that ignipuncture produced an adhesive inflammation, but that in none of his successful cases were there demonstrable tears. Wiener [53] called the result a proliferating retinitis.

The prognosis is best when a tear is present and its edges have been coapted.[30] It is good in traumatic detachment, less so in the myopic type and least of all in severely diseased conditions of the eye; the patient should be taught to avoid recurrences.[2]

Gonin [54] mentioned certain conditions that are common in young persons with myopia. In these, breaks occur at the ora serrata; the holes

evade observation and tend to spread; they are unfavorable for operation because a line of punctures is required and this leads to faulty reattachments.

Schoenberg [55] summarized the factors of his successes. Recovery depends on: (1) the selection of suitable cases, (2) accuracy of technic and (3) cooperation by the patients. The best results were achieved in the early cases with small or few tears, after proper localization with Schoenberg's set of drawings especially designed for the purpose and a searching study of all features of the topography of the detachment.

He said that the patient should lie on the operated side with both eyes bandaged for six days and with the foot of the bed elevated 12 inches (30 cm.). Little food and no bowel action should be permitted during this period. In six or seven more days, spent mostly in bed, the treatment should be complete.

Gonin's published successes have been remarkable.[1]

CORNEA

Sabatzky [56] described a method for the rapid healing of serpent ulcer with preservation of the transparency of the cornea. The cornea is anesthetized. The ulcer is cleansed and then curetted to remove mucus and necrotic cells. Synthetic wintergreen oil is massaged into the ulcer with a spatula or a glass rod. After two minutes the lesion is dried with cotton, and a dressing of atropine ointment and a bandage is used for one or two days.

The method is adaptable for abrasions, erosions and marginal and pneumococcal ulcers. The cornea heals without scars, facets, opacities or astigmatism. In twenty-three of his twenty-four cases vision was restored to 5/6.

Sabatzky said that wintergreen oil acts as a germicide and as a stimulant to the nutrition and growth of new transparent corneal tissue; it lowers the intra-ocular tension, and it clears scars and leukomas. He believed that there is some chemical union between the oil and the cell protoplasm.

Chromicized wire has been tried in the electrocauterization of serpent ulcers; the scars were smaller.[57] Fluorescein was applied to serpent ulcers and sensitized by ultraviolet light; the scars were smaller, flatter and more transparent.[58]

Copper thiosulphate has given good results in corneal scars caused by trachoma.[59] It is used locally by drop or by 10 per cent ointment with or without massage and the expression of the granules. It may be given intravenously; 2 Gm. of the salt are dissolved in freshly distilled water, and 1 cc. of 2 per cent copper sulphide is added. The

clear part of the solution is used. Ten injections, four days apart, are given. The temperature and the urine must be watched.

Knapp [60] treated patients with keratoconus by means of the galvanocautery. He first treated the apex of the cone with a 2 mm. ball tip down to the deepest layers, and then perforated them with a fine point. He applied atropine ointment and maintained a binocular bandage for from eight to fourteen days or until the anterior chamber was reformed. The eye operated on was then kept bandaged for five or six weeks; for a similar period the bandage was continued at night only.

The contact glass also has been recommended for keratoconus.[61] The blown glass was tolerated for one or two weeks, but was left off the eye for one day of each week.

Pischel [62] outlined a method for tattooing the cornea with gold or platinum chloride. The anesthetic was cocaine without epinephrine. The epithelium was scraped from the area to be treated. Hemorrhage was controlled without epinephrine. Gold chloride and sodium chloride of faintly acid reaction were applied on cotton to the area and renewed each sixty seconds for three minutes for a brown, and five minutes for a black pupil. Reduction was effected with epinephrine or a 2 per cent solution of tannic acid dropped on for one or two minutes. The area was flushed with physiologic solution of sodium chloride and a bandage was applied.

For platinum chloride, after anesthesia, the eye was flushed with sterile distilled water. Platinum chloride in a 2 per cent solution was applied for two minutes. Reduction was effected by using a freshly prepared solution of hydrazine hydrate for twenty-five seconds. The field was irrigated with sterile water. After two minutes the eye was flushed with physiologic solution of sodium chloride and a bandage was applied.

TRACHOMA

The use of diathermocoagulation on the granulations and pannus of trachoma by jump spark, at a distance of 1 or 2 mm., is rapid and bloodless, produces suppleness and flexibility in the scars and is given without loss of time from occupation.[63]

A running suture of number 0 catgut, from 3 to 9 o'clock around the limbus has been used successfully for trachomatous pannus.[64] The transplantation of the buccal mucosa for pannus, by slipping the graft under loops of conjunctiva, without sutures, worked well in some cases.[65]

Tracolysin, 0.5 cc., injected into the conjunctival sac as many as thirty times, has not given especially encouraging results.[66] Chaulmoogra oil was not found superior to olive oil;[67] it did not materially shorten the duration of treatment.[68]

VERNAL CONJUNCTIVITIS

Cauterization with ethyl chloride produced permanent cures in some cases. A contact glass was placed on the cornea to protect it. The grooves in the conjunctiva were filled with cocaine, ethyl chloride was applied, the nodules were clipped off smoothly, and the thermocautery was used to complete the treatment.[69]

Lactic acid applied in a 10 per cent solution for one or two minutes, followed by irrigations of boric acid or physiologic solution of sodium chloride, was found useful. The proliferated tissue may be curetted, and a peritomy performed.[70]

MUSCLES

Paralysis of the superior oblique muscle was treated by splitting the lateral and inferior recti; the lower half of the lateral rectus and the temporal half of the inferior rectus were each sutured to the limbus between the insertions of the lateral and inferior recti.[71]

A case of spastic squint was relieved by injecting alcohol along the course of the muscle causing it.[72] In a case of spastic entropion from trachoma alcohol was injected in the region of distribution of the facial nerve terminals to the lids.[73]

Maddox[74] devised a method of fusion training by means of a stereoscope and movable pictures. The patient manipulates the pictures in the instrument until they occupy a proper relationship, e. g., the bird inside the cage. The right hand is used to move the right picture and the left hand the left picture. This is intended to train the hand and eye of the same side together.

ANESTHETICS

"Avertin" (tribromethyl alcohol) may be given locally or by rectum. It produced effects like natural sleep without excitement, nausea or vomiting.[75]

Methylene bichloride, from 150 to 200 drops, was found useful for brief anesthesias. It is chemically pure, stable, safe, noninflammable and odorless, its administration is simple, it produces a longer effect than ethyl chloride and there is no nausea or other untoward after-effect.[76]

PHYSICAL THERAPY

Roentgen therapy excelled drugs in blepharitis because erythema stimulates the vital processes in damaged cells.[77] It has healed herpes of the cornea when used four times in 8 per cent of an erythema dose.[78] It has also been used advantageously in retinal venous thrombosis.[79] During the exposure the cornea may be protected with a gold plated

lead shell trimmed to fit and coated with a mixture of wax, paraffin and petrolatum.[80] Holes may be cut in the shell for the treatment of lesions of the iris.

In the treatment for interstitial keratitis longer rays caused necrosis, but shorter rays stimulated cicatrization. The dosage used was 400 R units at 180 kilovolts' penetration with 0.5 mm. of zinc and 3 mm. of aluminum filters. Four treatments were given one week apart. These were followed by thirty galvanic ionizations with solutions of zinc or copper over closed lids; the treatments, of thirty minutes each, were given on alternate days.[81] The entire course can be repeated.

Bucky's border rays have been found beneficial in superficial nonpyogenic diseases of the cornea and in scleritis.[82] The apparatus is inexpensive, the dosage is precise, the treatments are characterized by brevity, painlessness, simplicity and safety, and the disease is shortened in duration. The effects of the rays are not cumulative, and they are equal to ultraviolet, radium and roentgen rays. In chronic glaucoma the Bucky rays prolonged the effects of miotics.[83]

From thirty to forty applications of iontophoresis, according to Birnhauser's technic, have benefited corneal lesions and leukomas.[84]

Patients with phlyctenular keratoconjunctivitis were given ultraviolet light baths with the eyes protected;[85] the internal administration of calcium shortened the periods of treatment by about one-third.[86] In cases of ocular irritations from ultraviolet light, cycloplegics, cold compresses and smoked glasses are indicated.[87]

Radium has been used for vernal conjunctivitis. A deposit is made on lead foil, and the foil is folded over to envelop the deposit. The globe is protected, and the lids are everted; the dose is from 200 to 400 millicurie seconds, depending on the individual susceptibility of the patient.[88] Riggins[89] used low dosage, from 10 to 25 mg., with a thin screen, applied for ten minutes to each lid. From one to three treatments sufficed. The tissue partially atrophies, and the scars are soft and flexible.

Sarcoma of the choroid was treated by the implantation of radon seeds under it. One millicurie in a 0.5 mm. platinum filter was used for fourteen days. Five months later 5 millicuries in the same filter were used for ten days. The effect was found satisfactory after eight months.[90]

GLAUCOMA

Ergotamine tartrate (gynergen brand) from rye ergot, administered in oral doses of from 3 to 5 mg., or in hypodermic doses of 1.5 mg., lowered tension according to one author,[91] was equal in effect to pilocarpine according to another[92] and was without effect according to a third.[93]

In one case of absolute glaucoma the pain was controlled by the injection of alcohol into the gasserian ganglion.[94]

A radical cure for glaucoma was proposed by sclerociliarotomy with the thermocautery.[95] The sclera was tunneled 1 mm. behind the limbus and backward from 5 to 6 mm. The sclera, external aspect of the ciliary body and muscle and Schlemm's canal were included. The aqueous was evacuated. As soon as vitreous appeared, a snug bandage was applied.

MISCELLANEOUS

The feeding of liver or the administration of liver extract to infants has proved beneficial in the treatment for keratomalacia and hemeralopia.[96] It should be tried in retinitis pigmentosa and in retinal hemorrhages.

In ocular injuries when sympathetic ophthalmia is anticipated, autoserum should be given early and repeatedly.[97] The injured eye should not be removed until indicated by the reactions of the uninjured eye, which should be examined daily.

In cases of pulsating exophthalmos, Dorrance [98] ligated the common carotid and, after a week or two, all of its branches except the internal maxillary and the superficial temporal branches from the external carotid.

Heine [99] reported on the use of ground contact glasses for the correction of ametropia between 15 diopters of hyperopia and 20 diopters of myopia. Reductions of myopia, astigmatism and intraocular tension were observed. The method was proposed to arrest progressive myopia in children.

SUMMARY

The past year has provided encouraging progress in ophthalmic therapeutics, particularly as it applies to the prevention of blindness from detached retina and pneumococcal ulcer.

The dramatic interest developed in retinal detachment has given ophthalmologists a better comprehension of the subject and its management. The less spectacular announcement of a new treatment of promise for serpent ulcer will direct deserved attention to the cornea. Perhaps some one will soon devise a treatment for interstitial keratitis which will preserve for the cornea its transparency and optic integrity.

BIBLIOGRAPHY

1. Knapp, Arnold, in discussion of Schoenberg: Gonin Operation for Detachments of the Retina, abstr., Arch. Ophth. **4**:291 (Aug.) 1930.

2. Stallard, H. B.: Some Observations on the Causes and Treatment of Simple Detachment of the Retina, Brit. J. Ophth. **14**:122 (July) 1930.

3. Cords, R.: Detachment of the Retina Caused by Injury, Klin. Monatsbl. f. Augenh. **84**:222 (Feb.) 1930; abstr., Arch. Ophth. **4**:406 (Sept.) 1930.

4. Majewski, K.: Pathogenesis of Retinal Detachment in High Myopia, Klinika Oczna, December, 1929, p. 129; abstr., Am. J. Ophth. **13**:734 (Aug.) 1930.

5. MacCallan, A. F.: Binocular Detachment of the Retina in a Boy Aged 8, Arch. Ophth. **4**:145 (July) 1930.

6. Thompson, A. H., in discussion of MacCallan.

7. Wurz, R.: Traumatic Detachment of the Retina, Bratisl. lekár. listy **10**:13 (Jan.) 1930; abstr., Am. J. Ophth. **13**:549 (June) 1930.

8. Zahor, A.: Industrial Traumatic Detachment of the Retina, Bratisl. lekár. listy **9**:1133 (Oct.) 1929; abstr., Am. J. Ophth. **13**:560 (June) 1930.

9. Baurmann, M.: Mechanism of Retinal Detachment: The Physicochemical Qualities of the Vitreous Body, Arch. f. Ophth. **122**:415 (July) 1929; abstr., Arch. Ophth. **4**:357 (March) 1930.

10. de Decker, J. F.: Relation Between Detachment of the Retina and General and Local Disturbance in the Capillaries, Arch. f. Augenh. **100-101**:223 (July) 1929; abstr., Arch. Ophth. **4**:256 (Aug.) 1930.

11. Alperin, D.: Retinal Detachment Complicating Insulin Therapy, Am. J. Ophth. **12**:486 (June) 1929.

12. Kümmell, R.: Anatomy of Fresh Retinal Detachment, Arch. f. Augenh. **100-101**:314, 1929; abstr., Arch. Ophth. **3**:472 (April) 1930.

13. Deutschmann, R.: Retinal Tears, Especially as to Their Significance in Detachment of the Retina, Arch. f. Ophth. **122**:359, 1929; abstr., Am. J. Ophth. **13**:80 (Jan.) 1930.

14. Pascheff, C.: Spontaneous Cure of Retinal Detachment, Arch. Ophth. **4**:434 (Sept.) 1930.

15. Richardson, S.: Bilateral Retinal Detachment Complicating Toxemia of Pregnancy, J. Florida M. A. **16**:266 (Dec.) 1929; abstr., Am. J. Ophth. **13**:922 (Oct.) 1930.

16. Salit, P. W.: Biochemistry of the Aqueous, Lens and Vitreous, Arch. Ophth. **4**:374 (Sept.) 1930.

17. Fortin, E. P.: Notes on Retinal Detachment, Arch. de oftal. de Buenos Aires **4**:652 (Oct.) 1929; abstr., Am. J. Ophth. **13**:349 (April) 1930.

18. Vogt, A.: Retinal Detachment Healed by Ignipuncture, Klin. Monatsbl. f. Augenh. **82**:619 (May 17) 1929; abstr., Arch. Ophth. **2**:599 (Nov.) 1929.

19. Aschner, B.: Retinal Detachment and Venesection, München. med. Wchnschr. **76**:2135 (Dec. 20) 1929; abstr., Am. J. Ophth. **13**:448 (May) 1930.

20. Gonin, J.: Remarks and Comments on 240 Cases of Retinal Detachment, Ann. d'ocul. **167**:361 (May) 1930; abstr., Am. J. Ophth. **13**:843 (Sept.) 1930.

21. Vogt, A.: Further Experiences with Ignipuncture of the Retinal Tear in Retinal Detachment, Klin. Monatsbl. f. Augenh. **84**:305 (March) 1930; abstr., Am. J. Ophth. **13**:548 (June) 1930.

22. Gradle, H. S.: Ignipuncture in Detachment of the Retina, Am. J. Ophth. **13**:304 (April) 1930.

23. Sourdille, G.: Clinical Course of Retinal Detachment, Arch. Ophth. **4**:434 (Sept.) 1930.

24. Kirby, D. B., in discussion of Schoenberg: Arch. Ophth. **4**:291 (Aug.) 1930.

25. Syracuse, V. R.: Weekers Method of Experimental Production of Retinal Detachments, Arch. Ophth. **4**:300 (Aug.) 1930.

26. Sourdille, M. G.: Remarks on the Pathology and Treatment of Detachment of the Retina, Bull. Soc. d'opht. de Paris, February, 1929, p. 108; abstr., Brit. J. Ophth. **14**:307 (June) 1930.

27. Thompson, E. S., in discussion of Schoenberg: Arch. Ophth. **4**:291 (Aug.) 1930.

28. Amsler, M.: Detachment of the Vitreous, Arch. Ophth. **4**:433 (Sept.) 1930.

29. Perez Bufill: Surgical Treatment of Detachment of the Retina, Arch. de oftal. hispano-am. **29**:150 (March) 1929; abstr., Am. J. Ophth. **13**:182 (Feb.) 1930.

30. Meller, J.: Treatment of Detachment of the Retina by Ignipuncture, Ztschr. f. Augenh. **70**:207 (Feb.) 1930; abstr., Arch. Ophth. **4**:407 (Sept.) 1930.

31. Redslob, E.: Neuro-Epithelial Hyperplasia in Detachment of the Retina, Ann. d'ocul. **167**:104 (Feb.) 1930; abstr., Am. J. Ophth. **13**:548 (June) 1930.

32. Greeff, R.: Etiology of Detachment of the Retina, Arch. f. Augenh. **100-101**:116 (July) 1929; abstr., Am. J. Ophth. **12**:934 (Nov.) 1929.

33. Schoenberg, M. J.: Gonin Operation for Detachments of the Retina, abstr., Arch. Ophth. **4**:291 (Aug.) 1930.

34. Hamilton, J. B.: On Looking for Holes in the Retina, Brit. J. Ophth. **14**:455 (Sept.) 1930.

35. Arruga, H.: Treatment of Detachment of the Retina, Arch. de oftal. hispano-am. **29**:346 (Oct.) 1929; abstr., Arch. Ophth. **3**:356 (March) 1930.

36. Kerry, R.: Retinal Detachment, Brit. J. Ophth. **13**:447 (Sept.) 1929.

37. Jeandelize and Baudot: Treatment for Spontaneous Retinal Detachment by Gonin's Method, Arch. Ophth. **4**:435 (Sept.) 1930.

38. Crigler, L. W., in discussion of Schoenberg: Arch. Ophth. **4**:291 (Aug.) 1930.

39. Lindner, K.: On the Results Obtained up to the Present in the Treatment of Detached Retina by Gonin's Method, Wien. klin. Wchnschr. **43**:225, 1930; abstr., Brit. J. Ophth. **14**:304 (June) 1930.

40. Goalwin, H. A.: Optical Considerations in Localizing Retinal Tears, Arch. Ophth. **4**:298 (Aug.) 1930.

41. Amsler, M.: Markers for Gonin's Thermopuncture, Ann. d'ocul. **167**:115 (Feb.) 1930; abstr., Am. J. Ophth. **13**:545 (June) 1930.

42. Salzmann, M.: Localization Inside the Eye, Arch. f. Ophth. **123**:252 (Dec.) 1929; abstr., Arch. Ophth. **3**:630 (May) 1930.

43. Rubbrecht, R.: The Closure of Tears in the Retina, Arch. d'opht. **47**:160 (March) 1930; abstr., Am. J. Ophth. **13**:923 (Oct.) 1930.

44. Goldstein, I., in discussion of Schoenberg: Arch. Ophth. **4**:291 (Aug.) 1930.

45. Meller, J.: Treatment of Detached Retina by Ignipuncture, Ztschr. f. Augenh. **120**:207, 1930; abstr., Brit. J. Ophth. **14**:305 (June) 1930.

46. Badeaux, F.: Reflections on the Operative Treatment of Detachment of the Retina, Ann. d'ocul. **167**:383 (May) 1930; abstr., Am. J. Ophth. **13**:841 (Sept.) 1930.

47. Herzfeld, M. G.: Microscopic Observations in Experimental Ignipuncture of the Retina, Arch. Ophth. **4**:298 (Aug.) 1930.

48. Rubbrecht, M. R.: Closing of Retinal Tears, Bull. Soc. belge d'opht., 1929, p. 15; abstr., Am. J. Ophth. **13**:736 (Aug.) 1930.

49. Lindner, K.: New Method of Determining the Location of Lesions in the Eyeground: Its Application to Gonin's Method of Treatment for Retinal Detachment, Arch. f. Ophth. **123**:234 (Dec.) 1929; abstr., Arch. Ophth. **3**:629 (May) 1930.

50. Waldstein, E., in discussion of Schoenberg: Arch. Ophth. **4**:291 (Aug.) 1930.

51. Rubbrecht, R.: Operations for Retinal Detachment, Arch. Ophth. **4**:435 (Sept.) 1930.

52. Anklesaria, M. D.: Detachment of the Retina: A Complete Cure in a Myopic Case, Indian M. Gaz. **64**:186 (April) 1929; abstr., Am. J. Ophth. **12**:864 (Oct.) 1929.

53. Wiener, A., in discussion of Schoenberg: Arch. Ophth. **4**:291 (Aug.) 1930.

54. Gonin, J.: Retinal Disinsertions, Arch. Ophth. **4**:433 (Sept.) 1930.

55. Schoenberg, M. J.: Gonin Operation for Detachments of the Retina, Arch. Ophth. **3**:684 (June) 1930.

56. Sabatzky, K.: A New Method for Curing Serpent Ulcer with Preservation of Corneal Transparency, Klin. Monatsbl. f. Augenh. **83**:498 (Oct.-Nov.) 1929.

57. Vydovsky: Cauterization of Serpiginous Ulcers with Chromicized Wire, Oft. Sbornik **3**:523, 1929; abstr., Am. J. Ophth. **13**:265 (March) 1930.

58. Hollis and Linskz: The Treatment of Corneal Disease by Ultraviolet Light, Ztschr. f. Augenh. **68**:151 (June) 1929; abstr., Am. J. Ophth. **12**:857 (Oct.) 1929.

59. Stastnik, E.: Treatment of Trachoma with Copper Thiosulphate, Oft. Sbornik **3**:195, 1929; abstr., Am. J. Ophth. **13**:261 (March) 1930.

60. Knapp, A.: Keratoconus: Etiology and Treatment, Arch. Ophth. **2**:658 (Dec.) 1929.

61. Popovici: Keratoconus Treated by Mueller's and Zeiss' Contact Glass, Cluj. med., 1929; abstr., Arch. Ophth. **4**:113 (July) 1930.

62. Pischel, D. K.: Tattooing of the Cornea with Gold and Platinum Chloride, Arch. Ophth. **3**:176 (Feb.) 1930.

63. Monbrun, A.: Trachoma and Surgical Diathermy, Rev. internat. du trachome **6**:145 (Oct.) 1929; abstr., Am. J. Ophth. **13**:456 (May) 1930.

64. Moretti, E.: A New Operation for Trachomatous Corneal Pannus, Ann. di ottal. **57**:677 (Aug.-Sept.) 1929; abstr., Am. J. Ophth. **13**:457 (May) 1930.

65. Fazakas, A.: A New Method of Denig's Transplantation of Buccal Mucosa for the Treatment of Pannus, Ztschr. f. Augenh. **68**:357 (Aug.) 1929; abstr., Am. J. Ophth. **12**:1020 (Dec.) 1929.

66. Salvati, S.: Treatment of Trachoma and Its Complications by Tracolysin, J. Egyptian M. A. **12**:155 (Oct.) 1929; abstr., Am. J. Ophth. **13**:174 (Feb.) 1930.

67. Gala, A.: The Effect of Chaulmoogra Oil in Trachoma, Oft. Sbornik **3**:121, 1929; abstr., Am. J. Ophth. **13**:259 (March) 1930.

68. Wilson, R. D.: Chaulmoogra Oil in the Treatment of Trachoma as Compared with Copper Sulphate or Mercuric Perchloride, Third Ann. Rep. Res. Dept. Giza, Mem. Ophth. Lab., Cairo, 1928, p. 54; abstr., Arch. Ophth. **4**:407 (Sept.) 1930.

69. Strebel, J.: Permanent Cure of So-Called Vernal Catarrh by the Kelene (Ethyl Chloride) Cauterization Method, Schweiz. med. Wchnschr. **60**:227 (March 8) 1930; abstr., Am. J. Ophth. **13**:649 (July) 1930.

70. Tontscheff, S.: Treatment of Spring Catarrh with Lactic Acid, Klin. Monatsbl. f. Augenh. **83**:48 (July) 1929; abstr., Am. J. Ophth. **12**:856 (Oct.) 1929.

71. Aurand, L.: New Method of Replacing the Superior Oblique Muscle by Advancement of a Part of the External Rectus and a Part of the Inferior or of the Superior Rectus, Ann. d'ocul. **167**:213 (March) 1930; abstr., Am. J. Ophth. **13**:643 (July) 1930.

72. Salvati, G.: Treatment of Strabismus by Alcohol Injections, Ann. d'ocul. **167**:229 (March) 1930; abstr., Am. J. Ophth. **13**:639 (July) 1930.

73. Popovici: The Treatment of Entropion by de Wecker's Method, Cluj. med., 1929, no. 9,; abstr., Arch. Ophth. **3**:795 (June) 1930.

74. Maddox, E. E.: A New ("Eye and Hand") Method of Training Squints, Am. J. Ophth. **13**:379 (May) 1930.

75. Wessely, K.: Avertin Anesthesia in Ophthalmology, Arch. f. Augenh. **100-101**:556 (July) 1929; abstr., Am. J. Ophth. **12**:1012 (Dec.) 1929.

76. Stastnik, E.: Solaesthin in Ophthalmology, Oft. Sbornik **3**:405, 1929; abstr., Am. J. Ophth. **13**:255 (March) 1930.

77. Luzsa, A.: Roentgen Therapy of Blepharitis, Klin. Monatsbl. f. Augenh. **84**:76 (Jan.) 1930; abstr., Am. J. Ophth. **13**:358 (April) 1930.

78. Bernd, W.: Treatment of Herpes of the Cornea, Klin. Monatsbl. f. Augenh. **83**:818 (Dec.) 1929; abstr., Am. J. Ophth. **13**:460 (May) 1930.

79. Lowenstein, A., and Reiser, E.: Roentgen Treatment for Thrombosis of the Retinal Veins, Klin. Monatsbl. f. Augenh. **84**:230 (Feb.) 1930; abstr., Am. J. Ophth. **13**:546 (June) 1930.

80. Wölfflin, E.: A New Prosthesis for Protecting the Eye Against Roentgen Ray Lesions, Klin. Monatsbl. f. Augenh. **82**:813 (June) 1929; abstr., Am. J. Ophth. **12**:851 (Oct.) 1929.

81. Aureliano, F.: Technic of Physical Therapy in Keratitis Parenchymatosa, Ann. di ottal. e clin. ocul. **58**:45 (Jan.) 1930; abstr., Arch. Ophth. **4**:411 (Sept.) 1930.

82. Krasso, I.: The Treatment of Afflictions of the Anterior Segment with Bucky's Border Rays, Ztschr. f. Augenh. **71**:1 (April) 1930; abstr., Am. J. Ophth. **13**:829 (Sept.) 1930.

83. Krasso, I.: The Effect of General Radiation with Bucky's Rays on Glaucoma, Ztschr. f. Augenh. **69**:74 (Sept.) 1929; abstr., Am. J. Ophth. **13**:269 (March) 1930.

84. Ptashnick, D. B.: Iontophoresis and Its Use in Corneal Lesions, Arch. Oft. **7**:210, 1930; abstr., Am. J. Ophth. **13**:835 (Sept.) 1930.

85. Martinez, Nevot: Ultraviolet Light in the Treatment of Phlyctenular Keratoconjunctivitis, Arch. de oftal. hispano-am. **5**:740 (Aug.) 1929; abstr., Am. J. Ophth. **13**:175 (Feb.) 1930.

86. Cremer, M.: Calcium Therapy in Phlyctenular Disease, Arch. f. Augenh. **100-101**:729 (July) 1929; abstr., Arch. Ophth. **3**:644 (May) 1930.

87. Lear, E. G.: Pathologic Effects of Ultra Violet Rays on the Eye and Treatment, New York State J. Med. **29**:1270 (Oct. 15) 1929; abstr., Am. J. Ophth. **13**:558 (June) 1930.

88. Quick, D.: Radium in Vernal Catarrh, Arch. Ophth. **4**:212 (Aug.) 1930.

89. Riggins, I. W.: Use of Radium in the Treatment of Vernal Conjunctivitis, Radiol. Rev. **51**:451 (Sept.) 1929; abstr., Am. J. Ophth. **13**:174 (Feb.) 1930.

90. Moore, R. F.: Choroidal Sarcoma Treated by the Intraocular Insertion of Radon Seeds, Brit. J. Ophth. **14**:145 (April) 1930.

91. Glavan: The Action of Gynergen on Ocular Tension in Glaucoma, Cluj. med., 1929, no. 9; abstr., Arch. Ophth. **4**:246 (Aug.) 1930.

92. Popovici: Treatment of Glaucoma by Gynergen Sandoz, Cluj. med., 1929, no. 9; abstr., Arch. Ophth. **4**:114 (July) 1930.

93. Franti, J.: Clinical Experience Regarding Glaucoma Therapy with Preparations of Secale Cornutum, Oft. Sbornik **3**:331, 1929.

94. Alexander, W.: Absolute Glaucoma Rendered Permanently Painless and Ciliary Neuralgia Cured by Anesthetizing the Gasserian Ganglion, Klin. Monatsbl. f. Augenh. **84**:65 (Jan.) 1930; abstr., Arch. Ophth. **4**:246 (Aug.) 1930.

95. Fioro, T.: Radical Cure of Glaucoma by the Igneous Sclerociliarotomy of Fioro, Ann. di ottal. **57**:820 (Oct.-Dec.) 1929; abstr., Am. J. Ophth. **13**:657 (July) 1930.

96. Trantas: The Treatment of Hemeralopia and Keratomalacia by the Feeding of Liver, Arch. d'opht. **46**:551 (Sept.) 1929; abstr., Arch. Ophth. **4**:808 (June) 1930.

97. Guiral, R., and Guiral, R. I.: Treatment of Sympathetic Ophthalmia by Autoserum, Arch. de oftal. hispano-am. **30**:1 (Jan.) 1930; abstr., Arch. Ophth. **4**:126 (July) 1930.

98. Dorrance, G. M.: Operative Treatment of Pulsating Exophthalmos, Am. J. Ophth. **13**:675 (Aug.) 1930.

99. Heine, L.: Correction of Various Ametropias by Means of Ground Contact Glasses, München. med. Wchnschr. **77**:6 (Jan. 3) 1930; abstr., Am. J. Ophth. **13**:450 (May) 1930.

News and Notes

EDITED BY DR. JOHN HERBERT WAITE

GENERAL NEWS

Duke University Medical School and Hospital.—Dr. William H. Wilmer, of the Johns Hopkins Hospital, Baltimore, attended the opening of the Duke Medical School and Hospital at Durham, N. C., on April 20, 1931, as a delegate representing the American Ophthalmological Society. We are indebted to Dr. Wilmer for the following description of this noteworthy event: "In 1865, Durham was an insignificant way-station, consisting of a population of less than 100. At present, it houses over 52,000 persons. In this town, the fortune of James B. Duke was made in the manufacture and sale of cigarets. Outside of the city limits, Duke University, with its various schools, is placed in a beautiful tract of pine-covered land of over 5,000 acres. The physical plant is valued at more than $20,000,000, and there are more than 2,000 students. April 20, the day set for the dedication of the Duke University School of Medicine and Hospital, was most auspicious. A rain on the previous day had made the dogwood and judas tree blossoms particularly beautiful among the pines. The day was a full one. There were more than 118 delegates, representing various institutions of this country and Canada. More than 1,000 guests were seated for both lunch and dinner. The Hospital and Medical School form a unit with other schools on the campus. The buildings are of collegiate Gothic architecture, and are built of a beautiful native granite —gray, with just enough red to make the buildings attractive. The medical group of buildings cost about $4,000,000, and there is $6,000,000 for their endowment. The Hospital and Medical School have 456 beds and about 1,000 rooms. Last year, out of 2,000 applicants for the Medical School, 69 were accepted, and admitted into the freshman class. The method of selecting the students from such a great number is based on: (1) the general activities and intellectual interests of the applicant, as gathered from a personal application, and from letters from the teachers; (2) two years of selected college studies, and (3) a personal interview. By the omission of long summer vacations, and by continuous study, the student may obtain his medical degree in three calendar years. During this period of study, he is offered a most liberal elective system. The faculty consists of a fine body of well trained enthusiastic young men, all imbued with the spirit of research and eager to try the new experiment in medical education. The Department of Ophthalmology at Duke University will not have an independent existence. It is to be a subdepartment of the Department of Surgery. There will be an outpatient department, and also a limited number of beds for ophthalmologic patients. At present, Dr. Anderson, of Durham, is caring for the ophthalmologic activities."

Colorado Congress of Ophthalmology and Oto-Laryngology.—The ninth annual Summer Graduate Course and the Colorado Con-

gress of Ophthalmology and Oto-Laryngology will be held from July 20 to August 1, inclusive. The class will be divided into small sections for the demonstrations and clinics. Daily complimentary luncheons followed by round table discussions will be continued as a popular feature. The Congress will be held on Friday and Saturday, July 24 and 25, for the presentation and discussion of special papers. At the completion of the program, on the afternoon of July 24, there will be a motor trip into the Rocky Mountains followed by a complimentary banquet at the Mountain Home of the Motor Club of Colorado. Among those who have consented to give special courses this year are: Dr. C. S. O'Brien, Iowa City; Dr. F. H. Adler, Philadelphia; Dr. H. J. Howard and Dr. French K. Hansel, St. Louis; Dr. A. C. Furstenberg, Ann Arbor, Mich., and Dr. W. J. McNally, Montreal, Canada. Applications for the Graduate Course, accompanied by a check for $50, the total fee, should be sent to Dr. H. L. Whitaker, Corresponding Secretary-Treasurer, 1612 Tremont Place, Denver.

American Board for Ophthalmic Examinations.—The American Board for Ophthalmic Examinations will hold an examination at Denver on July 23, 1931. Information may be obtained from the Secretary, Dr. William H. Wilder, 122 South Michigan Avenue, Chicago.

Summer Graduate Course in Ophthalmology at Rochester, N. Y.—The Department of Ophthalmology of the University of Rochester will conduct its second annual summer course from August 3 to 7. The course will be limited to fifty members, and will cover ophthalmic surgery, ophthalmoscopy and medical ophthalmology, perimetry and ophthalmic neurology, slit-lamp microscopy, photography, ocular muscles, pathology, retinoscopy and refraction. Detailed information about the course may be obtained from Dr. John F. Gipner, Strong Memorial Hospital, Rochester, N. Y.

A Ten Month Demonstration of Hospital Care for People of Moderate Means.—In the *New England Medical Journal,* issue of April 30, 1931, Dr. F. A. Washburn summarized the work done at the Baker Memorial, a 330 bed hospital for people of moderate means, conducted as a unit of the Massachusetts General Hospital. Nursing care is provided by graduate nurses with the aid of pupil nurses. Special nurses are allowed only when the necessity for such service is evident to the attending physician and to the administration. Nonnursing duties are handled by floor secretaries and nurse helpers. Of its own volition, the attending staff at the Baker Memorial Hospital accepts a small regulated fee for its professional service. The maximum amount which can be charged to any one patient is $150, no matter how difficult the case, or how long the patient stays in the hospital. The hospital provides surgical instruments, and furnishes the etherizer, house officers and nurses for surgical work, and complete laboratory service for all types of cases. All records are typed and copies are forwarded to the patient's physician. Finally, the hospital collects the physician's bill, acting as his agent and turning the money over to him. In this manner, 1,973 patients have been cared for during the first ten months of the life of the institution. Of this total number, only 15 per cent needed special nursing. The average income

of the breadwinners of the families represented was $2,101.74 a year. The unpaid accounts are reported as 5 per cent for hospital accommodations and 8 per cent for professional service.

Chicago Post-Graduate Course in Ophthalmology.—A twelve month course in ophthalmology has been announced by the combined University Eye Clinics of Chicago, to start on Sept. 1, 1931. The class will be limited to twelve men, graduates from a class A medical school, with an internship in an accredited hospital or its equivalent in general practice. Clinical instruction will be given in groups of two students each. Address communications to Dr. Richard C. Gamble, Secretary, 30 North Michigan Avenue, Chicago.

Occupational Poisons in New York During 1930.—The New York State Department of Labor has just given out a statement concerning occupational poisons from which workers in the state have claimed compensation during 1930. Of 770 cases of occupational poisoning, 350 were due to lead, 36 to benzol, 29 to chromium, 21 to carbon monoxide and the balance to other chemicals. Although lead painting employs a much larger number of men, storage battery plants yield a much greater number of cases of lead poisoning. The increase in chrome plating has yielded a considerable number of cases of poisoning. The fumes of chromic acid may cause perforation of the nasal septum, and stubborn lesions of the skin.

Differential Diagnosis of Tuberculous Iridocyclitis.—At the next International Congress of Ophthalmology, to be held at Madrid in 1933, Dr. Henri Lagrange will give a report on the differential diagnosis of tuberculous iridocyclitis. Dr. Lagrange, of 5, Avenue Daniel Lesueur, Paris, would appreciate any reprints on this subject.

Courses for Teachers of Sight-Saving Classes.—For the training of teachers and supervisors of sight-saving classes, courses will be offered this summer at four universities: Tulane University, from June 15 to July 24; University of Chicago, from June 22 to July 24; Teachers College, Buffalo, from June 29 to August 7, and Columbia University, from July 6 to August 14. With less than 400 sight-saving classes, and more than 50,000 children in the United States requiring instruction of this type, there is plenty of scope for this work.

Oxford Ophthalmological Congress.—The Twenty-First Annual Meeting will be held at Keble College July 8 to 11, 1931. On July 9 there will be a symposium on "The Diagnosis of Intra-Cranial New Growths": Mr. Leslie Paton will discuss the subject from the aspect of ophthalmology, Sir Percy Sargent from the aspect of neurosurgery, Dr. H. M. Traquair from the aspect of perimetry and Dr. Arthur Schüller of Vienna from the aspect of radiology. In the afternoon of July 9, Prof. Elliot Smith will give an address on "The Evolution of the Instruments of Vision." On July 10, The Doyne Memorial Lecture will be delivered by Mr. Philip E. H. Adams of Oxford. Other addresses and papers will be given by Dr. Bailliart ("Tonometry"), by Mr. James Craig and Dr. Arthur Schüller ("Penetrating Wounds of the Eyeball") and by Dr. Bernard Samuels of New York, Dr. Curran of Kansas City and Mr. Rugg-Gunn.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

THE CRYSTALLOIDS IN THE HUMAN RETINA. W. KOLMER, Arch. f. Ophth. **124:** 661, 1930.

In 1918, Kolmer described peculiar inclusions in the large horizontal cells of the inner nuclear layer of the human retina and named them crystalloids. These inclusions can be demonstrated in thin horizontal sections treated with any good protoplasma stain (for instance, methyl-green-pyronine); they look like rods with pointed ends. Similar crystalloids have been found in the interstitial cells of the testicle (Reinke) and ovary (A. Kohn). Areas of cystic degeneration in the human retina show these crystalloids exceedingly well. In these specimens the inclusions assume needle shape and sometimes reach a length of 20 microns. The crystalloids seem to have functional relations to the end-plates of the rods and cones. They are present at the time of birth and appear to grow somewhat during life.

P. C. KRONFELD.

Aqueous Humor

PATHOLOGY OF THE ANTERIOR CHAMBER. G. LOPEZ ORTIN, Arch. de oftal. hispano-am. **30:** 372 (Aug.) 1930.

The author maintains that apart from secondary lesions in the anterior chamber to be found in different ocular diseases of other portions of the eye, a certain proportion of patients present primary lesions of the anterior chamber, which are accompanied by a certain feeling of heaviness, a very slight photophobia and a superficial pericorneal congestion, which may easily be overlooked. It may be binocular and short-lived, but usually is persistent and chronic with acute exacerbations.

C. E. FINLAY.

Conjunctiva

PROPHYLAXIS OF OPHTHALMIA NEONATORUM. VAN DER STRAETEN, Arch. d'opht. **47:** 587 (Sept.) 1930.

The author first reviews in some detail the original work of Crédé on ophthalmia neonatorum. He divides the prophylaxis of ophthalmia neonatorum into three stages: (1) the disinfection, as far as possible, of the genital tract of the mother who has a gonococcic infection; (2) the careful cleansing of the eyes and face of the baby immediately after delivery, and (3) the instillation of 2 per cent silver nitrate into the eyes. The author feels that there has been too great a tendency to look on the instillation of silver nitrate as the chief factor in prophylaxis. The other two procedures mentioned should not be neglected.

S. B. MARLOW.

SPOROTRICHOSIS OF THE BULBAR CONJUNCTIVA. V. AMIAS, Arch. de oftal. hispano-am. **30**: 644 (Dec.) 1930.

A case of sporotrichosis of traumatic origin (slight conjunctival injury with a chestnut tree branch) is reported. Some days after the injury, conjunctival ulceration, with a preauricular glandular infarct, occurred, and later the submaxillary glands became involved, with a febrile disturbance (38.3 C., 100.9 F.). Under treatment with antidiphtheritic serum, the submaxillary infarct and the fever disappeared, but the preauricular gland suppurated. After some time, the ulceration healed, but nodular lesions appeared in scattered spots over the conjunctiva, accompanied by intense conjunctival infiltration and a parenchymatous infiltration of the corneal center, which finally progressed to ulceration. At this stage, as sporotrichosis was suspected, cultures were made in Sabouraud's medium from the conjunctiva and the pus from the preauricular glands. The latter proved negative, but the former developed into typical cultures of *Sporotrichum beurmanni*. The patient finally recovered after treatment with potassium iodide, internally and externally. The author considers the primary lesion as a sporotrichosal chancre, following an infection on the site of the original traumatism, with a subsequent nodular infiltration. He reviews briefly the literature on the subject.

C. E. FINLAY.

Congenital Anomalies

A FAMILY AFFECTED WITH KERATOCONUS AND ANTERIOR POLAR CATARACT. P. SANDER, Brit. J. Ophth. **15**: 23 (Jan.) 1931.

The feature in this unusual family history was the presence in each eye of a father and three daughters of an anterior polar cataract in combination with typical keratoconus. The degree of the development of the symptoms increases with the age of the examined persons. All the members of the family present features of physical and mental degeneration.

The author says that it would be stretching the imagination to apply the hypothesis of the infection of the eyes during intra-uterine life with perforation of the cornea and penetration by either microbes, probably gonococci, or their toxins to the lens. It would be more natural to consider the polar cataract as one of the defects of development and nutrition, as with other stigmas of degeneration, for which no infection is considered necessary.

W. ZENTMAYER.

PERSISTENCE OF THE HYALOID ARTERY AND THE CANAL OF CLOQUET. DEJEAN, Arch. d'opht. **47**: 459 (July) 1930.

Dejean first describes a case in which a persistent hyaloid artery associated with a posterior polar cataract was carefully studied with the slit-lamp. The canal of Cloquet was traceable from the posterior surface of the lens to the disk. He discusses the formation of the vitreous and suggests that the Cloquet's canal normally persists in the form of the optically empty retrolental space. He agrees with Vogt in thinking that the arcuate line seen on the posterior surface of the lens is a rem-

nant of the attachment of Cloquet's canal to it. He reiterates his belief that the vitreous is composed of sheets which contain fluid and therefore should not be cut away when it escapes from a wound.

S. B. MARLOW.

ANOTHER CASE OF MARCUS GUNN'S PHENOMENON. W. MARIN AMAT, Arch. de oftal. hisp. am. **30:** 530 (Oct.) 1930.

After reporting a typical case—congenital, one-sided, complete ptosis, with opening of the eye on opening the mouth and on turning the chin to the opposite side and with paralysis of the external rectus, which had persisted without change since birth—the author reviews the existing literature with the different theories advanced in explanation, which he finds unsatisfactory. He still prefers the one he proposed in reporting three cases in 1919 and 1923, that of an anomalous peripheral connection of the fifth nerve with the levator palpebrae.

C. E. FINLAY.

Cornea and Sclera

AN EPHEMERAL FORM OF KERATITIS. LEMOINE AND VALOIS, Arch. d'opht. **47:** 788 (Nov.) 1930.

The authors have seen five cases of this condition in two years. It resembles closely superficial punctate keratitis, but differs from it in being of a more acute onset and much shorter duration. It occurs between the ages of 25 and 40 in previously healthy persons of both sexes. Its onset is characterized by sudden and intense pain. The conjunctiva is moderately injected and there is scarcely noticeable ciliary congestion. The cornea shows no evidence of disturbance on the usual examination, but with the slit-lamp pinpoint-sized erosions are visible in the central area. These stain with fluorescein. Recovery is prompt, and the authors have never seen loss of vision result. The differential diagnosis between herpes and superficial punctate keratitis is discussed.

S. B. MARLOW.

HISTOPATHOLOGY OF VON SZILY'S SCLEROPERIKERATITIS. P. VON PLANTA, Klin. Monatsbl. f. Augenh. **85:** 384 (Sept. 26) 1930.

Scleroperikeratitis, known in the ophthalmologic literature under divers terms, was clearly defined by von Szily in 1926. He considered it of tuberculous origin, depending on the histologic examination of one of his cases.

Three cases, observed and treated within the last three years at the University Eye Clinic of Basel, are reported in this article. Based on these cases, the author describes scleroperikeratitis as follows: The anterior portion of the globe is chiefly involved. The sclera and episclera develop a jelly-like swelling of a bluish-red hue. The infiltration of the corneal parenchyma progresses from the limbus toward the center. The disease, which resists every form of treatment at the beginning, may improve later, and in some cases vision also. No symptoms of manifest or latent tuberculosis are found. In two of the three cases, there was no reaction to tuberculin, and focal reaction was absent. Typical nodular

formations were found in the ciliary body, in the sclera and in the episcleral tissues. The nodules consisted of a bright nucleus, composed of epithelioid cells, and a wall or round cells. Numerous giant cells of the Langhans type were found. Many of the nodules contained blood vessels, but necrosis of the nodules was absent, indicating the absence of tuberculosis. The choroid showed infiltrations with plasma cells and a few small necrotic patches. Judging from the pathologic changes, the author doubts the tuberculous genesis, but does not reject it. He considers it possible that scleroperikeratitis presents some kind of an atypical, endogenous sympathetic ophthalmia, although the sclera and cornea are involved.

K. L. STOLL.

Experimental Pathology

EXPERIMENTAL STUDIES OF THE TUBERCULOTOXIC ETIOLOGY OF SYMPATHETIC OPHTHALMIA (GUILLERY). F. POOS and F. SARTORIUS, Arch. f. Ophth. **124:** 565, 1930.

The authors follow Guillery's method of implanting reed bags containing live tubercle bacilli into the vitreous of one eye of a rabbit and studying both eyes clinically and anatomically. In the large majority of these experiments, the uvea of the second eye responded to the toxemia with diffuse and localized lymphocytic infiltrates. Clinical symptoms were visible in the second eye in only those cases in which a real tuberculous uveitis developed in the first eye. These findings of Guillery's could be confirmed by Poos and Sartorius who, however, do not agree with the former's opinion of the tuberculotoxic etiology of sympathetic ophthalmia. Their main reasons are: The eye that contains the reed bag anatomically shows a toxic endophthalmitis and not the well defined picture of sympathizing ophthalmia. If the reed bag is inserted into the orbit behind the eyeball, it is not necessary to injure the corresponding eye in order to get lymphocytic infiltration in the second eye. If one eye is removed and then the reed bag implanted in its former place, the second eye developes the same histologic changes as those in the experiment just mentioned. The authors conclude that the reaction ("Mitreaktion") in the second eye is just a part of the general reaction of the entire reticulo-endothelial system to the tuberculotoxemia and has, therefore, nothing to do with sympathetic ophthalmia. P. C. KRONFELD.

LESIONS OF THE EYE CAUSED BY THE ENERGY OF EMANATING RAYS. A. VOGT, Klin. Monatsbl. f. Augenh. **85:** 321 (Sept. 26) 1930.

It is known that not all the ultraviolet, and even fewer of the ultrared, rays that strike the eye reach the retina. Vogt's former experiments have shown that a greater number of the invisible, short-waved ultrared rays than of the visible rays of an electric bulb reach the retina. The damage done in the macula by looking at the sun is due not only to the visible rays and those of the ultraviolet, but also to the ultrared rays. No damage will occur without absorption; the cornea, aqueous humor and vitreous will allow the light to pass through them, while the pigment of the macula will absorb short-waved and long-waved rays of light, resulting in destruction of the cones.

Vogt succeeded in producing burns in the retina of rabbits by isolated, short-waved, ultra-red rays, as illustrated by the colored pictures appended. The changes of the retina and choroid were of an inflammatory and necrotic nature. The experiments indicated that the pigment epithelium and the adjoining neuro-epithelium in the macula of people who gazed at the sun were burned through absorption of the visible and ultra-red light rays. Burns of the lids and the cornea received in the glacier districts may become evident many hours or days later, and they are due to the action of especially short-waved ultraviolet rays that exist in the high mountains. The action of these short-waved rays is considered by the author to be chemical, rather than thermic. A lightly clouded sky will favor these burns more than bright sunlight. The best protection, in the author's experience, is offered by yellow ferro-oxyde glasses, or Zeiss' Umbral glasses; some protection is given by untinted flint-glass spectacles, but those made of rock-crystal (quartz) are of no value.

The cataracts of glassblowers and men working in foundries are not caused by visible or ultraviolet light, nor could this type be produced experimentally by ultraviolet rays. They are caused by short-waved ultra-red rays of a wavelength of from 2,400 to 750 millimicrons. The author calls these rays the "penetrating ultra-red" which are chiefly absorbed by the lens and the pigment layer, according to his measurements. Vogt succeeded in producing a total cataract in a rabbit's eye by exposing it to these rays for three hours under an especially constructed filter. This rabbit's cataract, similar to that of the glassblowers, showed the most distinct opacities in the anterior cortex where the rays entered and in the posterior where they left the lens, while the nucleus had resisted them. Protection for the eyes of workers in these trades is obtained through the use of ferro-oxydul glass which absorbs the short-waved ultra-red rays to a large extent. The old-fashioned blue cobalt glasses are also useful in this respect.

The author points out that the quantity of rays used in producing these experimental cataracts was small, in fact, so small that it caused no sensation of warmth on the back of the hand, nor was the cornea of the rabbits ever affected, as long as it was kept moist.

Vogt made experiments on the composition of the rays emanating from glowing glass at a temperature of 1,400 to 1,500 degrees Celsius. He found that the intensity of the ultra-red rays is immensely superior to that of the visible and ultraviolet rays combined. It is the portion of the rays absorbed by the lens and not the portion that passes through it that causes the cataract.

The origin and progress of the cataract caused by roentgen rays differs from the swiftly developing cataract due to the ultra-red rays by appearing months after the exposure (in one rabbit after 165 days) and by progressing slowly. This experience should be remembered by those who advocate even small doses of roentgen rays for the treatment of blepharitis and other minor diseases of the eyes. It might be used, on the other hand, to ripen senile cataracts; it may be possible, also, that one single exposure will stimulate a newly beginning cataract to rapid progress in an eye that might have been useful for a number of years or decades.

K. L. STOLL.

Glaucoma

THE ALKALINE RESERVE OF THE BLOOD AND THE INTRA-OCULAR TENSION. FRADKIN, KRASNOFF and CHIFETZ, Russk. Arch. Opht. **7**: 786 (July) 1930.

In 1926, Meesman reported his theory of glaucoma based on observations that the increase of the alkalinity of the blood leads to hypertension, and that hypotension is produced by acidosis because of dehydration of the vitreous and the lens.

The problem of the relation between the reaction of the blood and the intra-ocular tension was approached in three ways: The first group of observations was made on thirty-eight glaucomatous patients, twenty-three of whom suffered from chronic simple glaucoma, three from acute and twelve from absolute glaucoma. The alkaline reserve of those patients determined by the Van Slyke method averaged 43.7. In the control group of fourteen normal eyes, the alkaline reserve of the blood was 45.4. In the second part of their work the authors determined the intra-ocular tension of patients with a high alkalinity of the blood. Forty-nine patients who suffered from cancer of various organs and nineteen persons with epilepsy gave tonometric readings within normal limits, from 12 to 26 mm. of mercury. The final and experimental part of the studies was done on eight rabbits; four of these were put on a diet causing acidosis, and the other four on a diet producing alkalosis. The intra-ocular tension taken in both groups of rabbits three weeks later gave normal tonometric readings.

The authors came to the following conclusions:

1. Meesman's theory of alkalosis being the cause of glaucoma is not justified by their studies.

2. The blood of glaucomatous patients shows a slight acidosis.

3. The tonometric readings in patients with alkalosis are within normal limits.

4. Experimental acidosis and alkalosis of the blood of rabbits does not influence the intra-ocular tension.

O. SITCHEVSKA.

Instruments

RESISTANCE PUPILLOSCOPE. S. ENGEL, Arch. f. Augenh. **103**: 657 (Dec.) 1930.

The author calls attention to the disadvantages of the Hess pupilloscope, particularly to the influence on the patient of movement of the lever necessary to change the illumination. The instrument of Sander is also objectionable in that the apparatus has to be placed too close to the patient's eye. In order to overcome these difficulties, he has devised an instrument by which a rapid change in the illumination may be made without any noticeable change to the patient which might distract his attention. The instrument consists of a series of resistances through which a current is passed to an electric lamp. The eye is illuminated at a constant intensity, which may be changed by pressing a lever.

This results in an exposure of the eye to two different intensities of light, one of which is constant. The other may be altered by changing the resistance. The motor and visual discriminative acuity can thus be determined.

F. H. ADLER.

Lacrimal Apparatus

TREATMENT OF CONGENITAL DACRYOCYSTITIS. YAGÜES GARCÍA, Arch. de oftal. hispano-am. **30:** 641 (Dec.) 1930.

After anatomic and pathologic considerations, the author states his preference for massage of the region of the lacrimal sac in a downward direction rather than probing, as advocated by some authorities, at least as a preliminary measure. He reports three cases, in two of which a cure was effected by massage.

C. E. FINLAY.

Lens

INTRA-CAPSULAR CATARACT EXTRACTION AT MOGA, PUNJAB. C. C. O'MALLEY, Brit. J. Ophth. **15:** 152 (March) 1931.

At Moga, all cataracts except those in young people, are extracted intracapsularly, and every type of lens is extracted with the lower pole first. The instruments are those introduced by Colonel Smith. The routine operation differs in some respects from that described by Smith as the "New Indian operation."

A brief description of the operation as done by Dr. Mathra Das is as follows:

A spring speculum is inserted, the outer lashes trimmed with scissors and the conjunctival sac thoroughly flushed with a solution of 1:3,000 mercuric chloride. A large corneal section is made with puncture just in the sclerotic and counterpuncture exactly at the limbus at 180 degrees. The section finishes above in clear cornea. A small iridectomy is done in all cases. The speculum is removed and a lid hook inserted by an assistant in such a way as to raise the upper lid, including the fornix, clear off the globe. The lower lid is controlled by the assistant's forefinger. The lid control takes all external pressure off the globe. Next comes delivery of the lens. With an uncanny accuracy, the result of endless practice, Mathra Das applies the lens hook at a certain point on the sclerotic, or on the cornea, as the case may be, and lifts up the lower pole with a smooth, uniform movement, causing the cornea to fold up behind the posterior face of the lens till the latter drops quietly from its final attachment at the upper pole. Much care is given to replacing the iris, as this is the most likely source of trouble in this operation. After the lens is delivered and the iris attended to, the operator takes control and closes the lids, applying a pad and bandage.

Mathra Das never uses a spatula for counterpressure as described by Smith, nor does he use an auxiliary instrument such as Fisher's needle. He keeps his left thumb over the eyebrow for control, but rarely uses it for counterpressure.

The author then gives in detail the steps of the operation. He does not see the necessity for counterpressure in any case. With a skilled hand, there are few lenses that cannot be delivered by the hook alone. He sees no reason why this operation should not be successfully used by European surgeons.

W. ZENTMAYER.

INTRACAPSULAR EXTRACTION OF CATARACT. H. ARRUGA, Arch. de oftal. hispano-am. **30:** 593 (Nov.) 1930.

The author reviews the history of intracapsular extraction of cataract, with special reference to modern procedures. The one that he employs is that of Stanculaenu-Török, which he has used in 204 cases during the last three years, with slight variations, such as preliminary pupillary dilation, akinesia, fixture of the superior rectus muscle, retrobulbar injection, canthotomy, preliminary conjunctival flap and variations in the sutures, all of which he describes in detail.

He next compares intracapsular extraction with the extracapsular methods, arriving at the following conclusions: Extracapsular extraction is applicable to all cases and is less prone to be complicated by loss of vitreous and prolapse of the iris; in from 10 to 20 per cent of the cases, however, it is followed by secondary cataract, which necessitates a slight secondary operation. Intracapsular extraction permits more rapid recovery of vision, with the absence of a postoperative reaction in the majority of cases; it can be performed before the maturity of the cataract and is not followed by a secondary cataract. It is, however, more difficult, is not applicable to all cases and at times is followed by a drawing up of the pupil toward the corneal scar.

Arruga has discarded Smith's method of intracapsular extraction. In comparison with the forceps method, he considers the cupping method as more complicated, more difficult and more liable to be accompanied by loss of vitreous, requiring pronounced mydriasis. The forceps operation is simpler and preferable.

C. E. FINLAY.

ORANGE DISCOLORATION OF THE ANTERIOR SEGMENT AFTER UNSUCCESSFUL CATARACT OPERATION. K. SAFAR, Arch. f. Ophth. **124:** 601, 1930.

In a previous paper Safar described a case of orange discoloration of the anterior segment (xanthomatosis bulbi) which was caused by lipoid infiltration of a granulation tissue that surrounded an old hemorrhage. Now Safar describes another case of a yellow mass in the anterior chamber which developed one year after attempted extraction of a catatract, during which the nucleus had been luxated into the vitreous. The postoperative course was uneventful, until three weeks after the operation when the first symptoms of an iridocyclitis were noticed. The patient was treated with injections of milk, which, however, did not prevent the onset of a severe iritis five months after the operation, at which time the luxated lens was still visible in the lower part of the vitreous. One year after the operation, the typical picture of xanthomatosis bulbi with a big yellow mass in the anterior chamber was found. The patient submitted to enucleation because the eye was blind and still somewhat irritated. After cutting off the calotte, it was surprising

to find the nucleus of the lens in the anterior chamber embedded in a granulation tissue that showed infiltration with pus cells and lipoids. The lens had probably migrated from the vitreous into the anterior chamber, the way irritating foreign bodies frequently do. This migration is usually accompanied by a severe iridocyclitis and anatomically by aseptic suppuration, which subsides immediately after removal of the foreign body. Another possible explanation of the presence of the nucleus in the anterior chamber is its luxation into the anterior chamber inflicted by the patient when he stooped over. P. C. KRONFELD.

Lids

PALPEBRAL COMPLICATION IN A CASE OF KAPOSI'S SARCOMATOSIS. BENITO JUST TRISCORNIA, Arch. de oftal. de Buenos Aires **5:** 392 (Sept.) 1930.

The author reports a case of a palpebral localization in generalized sarcomatosis of Kaposi. An enormous nodular tumor of the right lower lid was removed. There was histologic confirmation of the diagnosis. Local metastasis occurred, the patient dying a few months later.

C. E. FINLAY.

Methods of Examination

LOCALIZATION THROUGH THE SCLERA OF OPHTHALMOSCOPIC LESIONS. K. W. MAJEWSKI, Arch. d'opht. **47:** 440 (July) 1930.

The introduction of Gonin's operation for detachment of the retina has made necessary the localization of retinal tears on the sclera. Several difficult and complicated procedures have been proposed. In this paper, Majewski suggests the use of a scleral lamp such as Lang's, which is used for transillumination. The examiner locates the retinal tear with the ophthalmoscope. An assistant then puts the scleral lamp under the guidance of the ophthalmoscopic examiner on the sclera at the place exactly corresponding to the retinal tear; this spot is then marked. This simple procedure will frequently be sufficient as the majority of the tears are anterior to the equator. In those cases in which the tears are more deeply situated, the author does not hesitate to dissect the conjunctiva and underlying structures before applying the scleral lamp. The author admits that the method has not been thoroughly proved, but hopes that future experience and modification will result in increased accuracy and usefulness. S. B. MARLOW

TARSAL BIOMICROSCOPY IN SOME TYPES OF CONJUNCTIVITIS. CUENOD and R. NATAF, Arch. d'opht. **47:** 543 (Aug.) 1930.

This paper is a continuation of a study previously outlined. The authors feel that this method of examination reveals valuable information not only on the phenomena of various types of conjunctival inflammation but also perhaps on inflammation in general. In this report they describe the appearance of the normal conjunctiva and the changes that take place as the result of irritation from a foreign body, due to a Koch-

Weeks infection, in follicular conjunctivitis and in vernal catarrh. The essential differences in the changes seen are illustrated in schematic sketches. They are of the opinion that this form of clinical study is especially important in trachoma. Although complete laboratory methods are sometimes not available for study of these cases, the authors feel that any one can make use of this method of examination in his office.

S. B. MARLOW.

Neurology

HERPES ZOSTER OPHTHALMICUS: AN UNUSUAL CASE. L. S. POWELL, Am. J. Ophth. **13**: 796 (Sept.) 1930.

The author describes herpes zoster ophthalmicus and discusses its etiology, pathology and treatment. A man, aged 40, complained of severe frontal headache, particularly on the right side, which had persisted for forty-eight hours. There was redness of the palpebral and bulbar conjunctivae of the right eye, which was otherwise normal except for a distinct reduction of corneal anesthesia. The left eye was normal, and vision was 20/20 in each eye. The next day, February 23, a typical herpetic eruption appeared in the right frontal area extending just beyond the midline of the forehead and as high as the parietal bone. It involved the right temporal area as far as the level of the outer canthus and included the upper and lower eyelids, the right inner canthus and the right side of the nose down to and including the tip. The cornea was not involved though the pain was excruciating. On March 4, the posterior surface of the cornea in the pupillary area was covered with fine distinctly separated opaque beads. Ciliary injection and tenderness also appeared. On March 18, the complete, right facial paralysis developed including loss of taste of the right side of the tongue; the patient was considerably annoyed by a continual tingling sensation of the right side of the tongue and throat as low as the thyroid cartilage. The voice was markedly changed, being weak and hoarse. The right vocal cord was noticeably less responsive on phonation, although it did not remain in the cadaveric position. There was partial anesthesia of the right side of the palate and pharynx. Extraction of two upper molars seemed to help the facial paralysis. The uveitis continued, and the eye was kept atropinized until May 13, when practically all tenderness and injection had disappeared. At this time there was marked residual facial palsy, vision was 20/50 and corneal anesthesia remained. Voice and vocal cord excursions were normal, but there was still some tingling of the right side of the tongue and throat.

W. S. REESE

Ocular Muscles

SPONTANEOUS NYSTAGMUS IN CONGENITAL SYPHILIS. N. ASHERSON, Arch. Dis. Childhood **5**: 331 (Oct.) 1930.

Forty children with congenital syphilis were examined for attacks of spontaneous giddiness and nystagmus (Hennebert's syndrome). These patients had been under treatment for some time. In eight cases, in which the tympanic membrane was intact, nystagmus was produced by insertion of a finger into the external auditory meatus.

Although spontaneous nystagmus was elicited in these cases, no one instance satisfied the criterion of Hennebert, namely, that compression and rarefaction of the column of air in the meatus produced an exaggeration of the nystagmus.

Thus, from this small series of cases, one is driven to the conclusion that nystagmus, demonstrated in the usual manner, is a not uncommon concomitant of hereditary syphilis among treated infants and children, although a true Hennebert's phenomenon was not demonstrated in any of the treated patients described. What part the antisyphilitic treatment has played in preventing the production of this phenomenon must remain a matter for conjecture. KELLY.

Operations

TRIAL EXERCISES AND NEW PROCEDURES IN OCULAR SURGERY WITH TWO KERATOMES. E. AUBARET, Arch. d'opht. **47**: 577 (Sept.) 1930.

In this paper the author describes the use of two keratomes or needles for the performance of operations on the globe. He presents a plan for becoming familiar with this method of operating so that ultimately the surgeon may apply it to operations for cataract. His plan begins with tattooing of the cornea. The second procedure advocated for trial is paracentesis with two knives, the two incisions being made on opposite sides of the cornea. This procedure is applied to hyphema, hypopyon keratitis and in traumatic and secondary cataract. He describes a method of internal iridocapsulectomy, iris forceps being inserted to grasp the iris through one incision and de Wecker scissors through the other. The third feature of his plan is a method for amputation of the cornea by means of two keratomes. S. B. MARLOW.

TREPHINING OF THE CORNEA IN REMOVAL OF A MELANOSARCOMA OF THE IRIS. A. N. MURSIN, Klin. Monatsbl. f. Augenh. **85**: 416 (Sept. 26) 1930.

Considering the importance of removing a malign tumor of the iris in toto, so as to avoid a hemorrhage from the tumor and possible dissemination of cells, the author trephined the cornea in one of his cases. It was a melanosarcoma, measuring 7 mm. in its vertical, and 5 mm. in its horizontal, diameter, involving the temporal lower portion of the iris and covering about two thirds of the pupil. Hippel's trephine of 4 mm. was used in such a way that a bridge was left toward the sclera on the corneal disk and a conjunctival flap was formed adjoining the trephining area. The tumor prolapsed at once, pushing the corneal disk aside, and it could be readily removed. Recovery was prompt, and no recurrence was observed four months later when the corneal disk was clear. The anterior chamber had a normal depth, and vision equaled 0.3 of the normal. The author recommends this operation for the removal of cysts of the iris and of nonmagnetic foreign bodies and, possibly, of tuberculous nodules of the iris. K. L. STOLL.

Orbit, Eyeball and Accessory Sinuses

TUBERCULOSIS OF THE EYE. R. I. LLOYD, Am. J. Ophth. 13:753 (Sept.) 1930.

The author gives a rather brief history of the contributions to our knowledge of ocular tuberculosis. He enumerates its outstanding diagnostic features and states that, in his opinion, most of the so-called focal infections of the eye are really tuberculous. The relapses of these various diseases, he states, are due to periods of lowered resistance. The differential diagnosis of syphilis and tuberculosis of the eye is discussed, and dependence on roentgen examination to the exclusion of skill in physical examination in the diagnosis of pulmonary tuberculosis is decried. The different types of tuberculosis of the fundus are discussed and also the resultant changes in other ocular structures, should the process progress. In the author's opinion, roentgen therapy is the best treatment. Three or four exposures of a 30 to 40 per cent skin erythema dose are given at intervals of a week, the eye being shielded by aluminum or silver. The vitreous exudates begin to clear after the first dose, and increased tension is relieved. Inunctions of a proprietary tuberculin ointment are of value. Injections of tuberculin are not used. The conglomerate lesion of the choroid seems to respond best. The author considers that type of lesion simulating disseminated choroiditis a variation of the conglomerate lesion. He believes that intra-ocular hemorrhage in young persons should be considered tuberculous unless proved otherwise. Iritis, iridocyclitis and uveitis are discussed, and a typical case cited; heterochromic cyclitis is also discussed. The rôle of trauma in these cases is mentioned. According to the author, phlyctenular disease is on the wane because of better living conditions. The value of the slit-lamp in diagnosing these various conditions is stressed. Twelve cases are reported, and a number of illustrations given. An extensive bibliography is appended.

W. S. REESE.

A CLINICAL STUDY OF SIXTEEN CASES OF OCULAR TUBERCULOSIS. G. F. SUKER and B. CUSHMAN, Am. J. Ophth. 13:781 (Sept.) 1930.

Allergy in tuberculosis is discussed, and a brief review of the history and literature of ocular tuberculosis given. The cases reported were observed for from six months to two and one-half years. Tuberculin was the main therapy, but general care was emphasized, and rest, diet, cod liver oil and ultraviolet radiation were used as well as local medicaments. After a normal temperature record of forty-eight hours and a negative general examination, Kochs' old tuberculin was given for diagnosis in ascending doses until 10 mg. had been given. If no sensitivity was evident, the inflammatory process was not considered tuberculous. These increased doses were watched carefully. The reactions varied from a rise in temperature to between 99 and 102.4 F., and the local reactions were very positive. No ill effects were noted from these carefully guarded diagnostic doses; indeed, they caused a decrease in the pain and injection, and in the number of cells in the anterior chamber; the pupil dilated more promptly, and improvement would be noted from that time. Nonspecific proteins were used in several cases without any

apparent effect. For treatment, a vaccine made up of virulent strains of human and bovine types of tubercle bacilli was used. The doses were regulated entirely by the individual response. In each case all foci of infection were cleared up as far as possible. The authors feel that the tuberculous condition was definitely shortened by the use of tuberculin and general care. Sixteen cases are reported, and the following summary given:

1. Chronic inflammatory conditions of the eyes are often tuberculous.
2. Tuberculin may be used in selected cases.
3. General therapy is as important as specific therapy, and fundamentally, improper nourishment may be the basic factor in the development of a tuberculous infection as well as proper nourishment the great factor in its cure.

W. S. REESE.

OCULAR MYIASIS. C. P. SCHENCK, Am. J. Ophth. 13:801 (Sept.) 1930.

The author discusses myiasis and notes its rarity as an ocular infestation. The insect may deposit its eggs in the conjunctival sac or in the nose, whence access to the conjunctival sac may be gained through the lacrimal passages or by burrowing through the tissues. They may pass into the eyeball through the central artery of the retina, or a ciliary artery, or may burrow into the eyeball from the conjunctival culdesac. A mechanic felt a foreign body strike his eye. Six or eight hours later, twenty-five larvae were removed from the conjunctival sac. Eversion of the lower lid revealed what looked like a minute dumb-bell progressing with short jerky movements. Careful focusing revealed this to be the anterior end of an almost transparent body with about eight segments which adhered with remarkable tenacity to the conjunctiva. When removed, it proved to be a larva or maggot. A number were found in the folds of the lower culdesac. Two larvae had worked their way beneath the bulbar conjunctiva. The convex side of a curved iris forceps was laid against the conjunctiva, and this together with the larvae drawn away from the sclera, and the entire mass touched with the electrocautery. It is believed that they were larvae of *Oestrus ovis,* or sheep-bot. They were about 1 mm. or less in length, exhibited about eight segments and had dark hooks or bristle-like processes along the head and sides.

W. S. REESE.

TUBERCULOSIS OF THE EYEBALL AND ADNEXA IN EGYPT. R. P. WILSON, Fourth Ann. Rep. Giza Mem. Laboratory, 1929, p. 46.

The statistics for Egypt show that the mortality rate from all forms of tuberculosis is probably much higher than in America or Europe, but from present investigations it would appear that tuberculosis as a cause of intra-ocular disease is to be considered as rare. The author expresses the opinion that so far as Egypt is concerned tuberculosis plays a much more prominent part in the etiology of diseases of the cornea than is usually admitted.

In the last seventeen years only twenty-one cases of ocular tuberculosis have been recorded by the pathologists to the Government Ophthalmological Hospitals. In none of the cases did the surgeons notice any

signs of tuberculosis of other parts of the body. The figures show that so far as the eye is concerned tuberculosis has a special predilection for the conjunctiva, 33.3 per cent, and for the uvea, 33.3 per cent. In fourteen of twenty-one cases the patients were female. This disease is essentially one of early life. Histologically, the ocular lesions did not differ from tuberculosis foci seen in other parts of the body. Caseation was seen in only seven of the cases. The tubercle bacillus was not demonstrated in situ.

W. ZENTMAYER.

Refraction and Accommodation

UNAIDED VISION OF THE ASTIGMATIC EYE. L. SALLMANN, Arch. f. Ophth. **124:** 605, (1930)

The author studied the behavior of the unaided astigmatic eye in regard to the plane on which it focuses when looking at distant or nearby objects. In the literature on this subject it had been stated that whether the astigmatic eye brings the anterior or the posterior focal line or a plane between them on to the retina depended mainly on the structure of the object. The author determined the refraction of a large number of astigmatic eyes by careful retinoscopy under homatropine. When the pupil and accommodation returned to normal, the patient was tested without his glasses. While reading on the Snellen chart, his gaze was suddenly directed at a star figure and then back again to the Snellen chart. By the foregoing and several other methods it could be determined which principal section of the eye received the more distinct images. Patients with simple hyperopic astigmatism usually focused with their hyperopic meridian. Patients with compound hyperopic astigmatism preferred the stronger hyperopic meridian. The same mechanism was found in eyes with mixed astigmatism when they were tested for near vision. In general, there is a tendency to accommodate to such an extent that the posterior focal line is brought on to the retina. Shape and structure of the seen object do not influence the described tendency nor does the position of the principal section in the eye. It is difficult to determine whether or not the foregoing tendency is kept up during ordinary reading. It is, however, likely that the unaided astigmatic eye usually reads with a plane nearer its posterior focal line coinciding with the retina.

P. C. KRONFELD.

REFRACTION IN TWINS: ANISOMETROPIA AND CORNEAL REFRACTION. P. J. WAARDENBURG, Klin. Monatsbl. f. Augenh. **84:** 593 (May) 1930; MODIFICATION OF CORNEAL REFRACTION. Ibid. **84:** 788 (June) 1930; CORNEAL ASTIGMATISM AND CORNEAL REFRACTION. Ibid. **84:** 795 (June) 1930; **85:** 31 (July) 1930.

This series of four articles, comprising about 85 pages, treats of the various hereditary phases of refraction, especially that of twins. A number of tables and statistics is illustrative of the material. The first article will be considered chiefly in this abstract which also contains some of the essential points of the other articles. The second article, based on 100 cases, describes anisometropia with reference to heredity

and its occurrence in twins. The third paper furnishes interesting data on the refraction of microcornea, microphthalmus, ectopia of the pupil and the lens, coloboma of the iris, choroid and optic nerve, heterochromia and other malformations. The fourth contains a large number of tables on astigmatism, comparisons of refraction of the members of several families, and explanations of remarks contained in the preceding articles.

Comparative research on monochorionic and dichorionic twins allows conclusions regarding the heredity of a single characteristic and the importance of hereditary disposition. The preponderance of similar traits inherited by monochorionic twins and the divergence in this respect of dichorionic twins, even if they belong to the same sex, is of fundamental importance in these considerations. The research on twins, furthermore, permits conclusions regarding the modification of divers traits.

It is Waardenburg's contention that a distinct difference between the corneal and general refraction of monochorionic and dichorionic twins can statistically be established since the heredity of these factors has been proved. He supports this statement by the histories of thirty-one pairs of monochorionic twins, sixteen of whom were of the same sex. He also confirms his own observations with those on 137 monochorionic and 55 dichorionic pairs of twins, which were hitherto published in the ophthalmologic literature. The only other systematic comparative reasearch in this respect has been done by Jablonsky and Schmidt.

The refraction found in both types of twins varied between 20 diopters of myopia and 3 diopters of hyperopia. The following details were found: The latitude of modification of the total refraction equaled 2.25 diopters, not exceeding 1 diopter in 96 per cent of the cases; it amounted to 1.9 diopters in the cases of normal corneal refraction, to 1 diopter in their corneal astigmatism. The latitude of modification of the regular and inverse total astigmatism was 1 diopter each, with one exception of 2 diopters. A considerable discordance of one or two of the four eyes was found in only 9 of the 137 pairs of monochorionic twins, usually of the astigmatic, rarely of the spheric, total refraction, or of both. The astigmatism is considered an irregular, and occasionally retrogressive phenomenon of a changing type. The monochorionic twins show an extraordinary concordance as to the corneal radius, the corneal refraction and total refraction, while the dichorionic twins incline to the opposite. This is surprising because the factors of development prior to birth differ more in the former, than in the latter type of twins; a wider latitude of modification should, therefore, be expected in monochorionic twins, especially for the varying symptoms. The larger incongruence of the astigmatic and normal corneal refraction in dichorionic twins is proof of the importance of hereditary inclination for the resulting optical component. The astigmatic and spheric discordance in the few exceptions of monochorionic twins is due, in the author's opinion, to epigentic disturbances, but not to hereditary variations. The decided discordance of refraction of many dichorionic twins, on the other hand, is a consequence of hereditary variations. Emmetropia, anisometropia and the origin of myopia receive due consideration. Although dynamic

emmetropia is present in some cases, no reason has been seen for establishing a rule for its further development. Emmetropia may occur in all of the four eyes, yet, it has its spheric and astigmatic latitude of modification, corresponding to that found in every type of refraction in the eyes of adults.

The direction of the principal meridians of the system of axes in astigmatism, including the inverse type, is due to heredity and it is subject to considerable variations. Intermediary astigmatism may occur in heterozygotes. As a consequence of disturbances of the dominants low degrees of anisometropia are directly paratypical, while higher degrees are indirectly paratypical. Anisometropia and bilateral homologous errors of refraction alternate within the same families. The course of the development of myopia and progressive myopia are chiefly influenced by heredity. No conclusive data was gained. It is significant, however, that one pair of monochorionic twins, the author's own children, developed myopia at the age of 8 years, and that in another pair of the same monochorionic type the myopia progressed in both girls, although only one wore her glasses and both followed different occupations after graduating from school. Unnatural interferences by the environment are responsible for permanent changes in the growing eye. Only the extent of the hereditary inclination can be established by the research on twins, but it cannot give a clue as to the number of inherited factors producing a certain symptom.

A large number of incidental observations are contained in these articles, e. g., the hereditary occurrence of nevi of the iris, the formation of the seam of the pupil and of opacities of the lens, the excavation of the disk and myopic cones. Records of measurements of the eyes and of the length of the lacrimal canaliculi are given with references to heredity. Paratypical influences, in the author's opinion, cause partial heterochromia, the preservation of small remnants of the pupillary membrane and the variations in which the central vessels appear in the disk.

K. L. STOLL

Retina and Optic Nerve

RETINITIS NEPHRITICA OR ALBUMINURICA. N. PINES, Brit. J. Ophth. **15:** 75 (Feb.); 129 (March) 1931.

The author states that this paper is the third and last part of a chain of clinical investigations. All the work is the outcome of general practice in which the ophthalmoscope was used merely as a means of thorough clinical examination. It is as much an essay in general medicine as in ophthalmology, and its chief value, if any, lies in demonstrating the importance of an early ophthalmoscopic examination.

The papers do not admit readily of abstracting. The author's summary is as follows:

1. Edema of the retinal anterior layers is seen ophthalmoscopically as a fine veil covering the larger vessels. If fully developed, it leads to "wool-patches" in the retina.

2. Retinal edema is usually combined with renal insufficiency of varying degrees and decreases or increases approximately pari passu with the latter, but an invariably coexisting condition is the presence of

arterial hypertension. With a normal blood pressure, retinal edema means only a deficient oxygenation of the retinal cells.

3. Albuminuric retinitis is ophthalmoscopically different from the sclerotic form. The appearance of this retinal edema will therefore mean for the patient all the difference between benign and malignant nephrosclerosis; its degree and protean character will be analogous to what has been previously said about nephrosclerosis in general. From the point of view of the organism, retinitis albuminurica always means an inefficient kidney, although biochemical tests may be satisfactory.

4. It is not yet proved that retinitis albuminurica is caused by disease of the kidney; both organs may suffer from the same toxin. The retina is more readily affected than any other part of the central nervous system, and this may be explained by the peculiarities of its histologic structure. If the histology of the kidney were to prove similar in this respect to that of the retina, it would explain the affinity of both organs when diseased.

5. The disease of the kidney that is characterized by fully developed retinitis albuminurica is clinically different from any other form of nephritis, and to it alone the term of "true interstitial nephritis" ought to be applied. It is a fatal disease of comparatively short duration, probably connected with a parenteral infection of the body, and its prognosis is bad in spite of possibly good results from biochemical tests.

W. ZENTMAYER.

ANGIOID STREAKS OF THE RETINA. R. P. WILSON, Fourth Ann. Rep. Giza Mem. Laboratory, 1929, p. 61.

This interesting condition was seen in a man, aged 26. He had been seen by another oculist four years previously who at that time noted the lesions associated with many retinal hemorrhages. When examined by the author, no hemorrhages were visible.

There was marked myopic choroidal atrophy; nevertheless, the angioid streaks were clearly visible anterior to these changes but posterior to the retinal vessels. (Illustrated by fundus photographs.)

W. ZENTMAYER.

Therapeutics

THE TREATMENT OF PAINFUL EYES WITH VISION BY MEANS OF THE ORBITAL INJECTION OF MODERATELY CONCENTRATED ALCOHOL. L. WEEKERS, Arch. d'opht. **47**: 299 (May) 1930.

The author confirms the reports of others on the treatment of painful blind eyes by means of the orbital injection of alcohol (80 per cent) with the preservation of the globe. The success and lack of apparent harm of this treatment in such cases led him to try its use on painful eyes still retaining some vision. He was so encouraged that he has come to use it in severe cases of corneal ulcer, hypertensive iridocyclitis, herpetic diseases of the cornea, etc., with such severe pain that the patient becomes greatly demoralized. He has had no serious complications arise from the injection. He began by using 5 per cent solutions, but found the effects too transient. He has not used a solution stronger than 40 per cent. The injection is made according to the method used for retro-ocular anesthesia. One cubic centimeter of 2 per cent procaine hydrochloride is first injected, the needle being allowed to

remain in place, and after a few minutes 1 cc. of from 20 to 40 per cent alcohol is slowly injected. The needle should be 3.5 cm. long and its point should be situated near the center of the orbit; special care should be taken that the injection is not made along the outer wall, for paralysis of the external rectus muscle can be produced.

Aside from the relief from pain and the action on the intra-ocular tension, these injections have no influence on the evolution of the ocular disease. They are not a panacea. They give the patient the necessary patience to allow the physician to carry out treatment. Their effect is particularly valuable in cases of iridocyclitis with increased tension.

S. B. MARLOW.

THREE CASES OF TUBERCULOUS RETINITIS TREATED WITH A NEW JAPANESE POLYVALENT TUBERCULOSIS VACCINE. Y. SHOJI, Klin. Monatsbl. f. Augenh. **85:** 161 (Aug.) 1930.

This type of retinitis is characterized by multiple white dots which are scattered all over the retina, excepting the macula, by hyperemia of the disks, enlarged central veins and hemorrhages. Opacities of the vitreous or any pathologic changes of the anterior portion of the globes were not noticed during the chronic course of the disease. The Wassermann test was negative in the three cases presented. In two of them, the patients, young girls, aged 17 and 24, respectively, gave positive reactions to Pirquet's test, and the third patient, a boy, aged 13, gave a negative reaction. Cures were obtained in these three cases by a polyvalent tuberculosis vaccine made of an apathogenous, easily absorbable, native bacillus protoplasma. Prepared by Arima, Aoyama and Ohnawa, it was named "AO" after its inventors, and has been used in Japan with satisfactory results for a number of years (*Deutsche med. Wchnschr.* **50:** 666 [May 23] 1924). It was successfully employed by the author in twenty-four cases of supposedly tuberculous inflammation of the anterior portion of the globe, phlebitis of the retina and neuroretinitis. Shoji compares his case with those of A. Knapp (*Tr. Am. Ophth. Soc.* **13:** 486, 1913), with reference to their appearance and course, and also the result obtained with tuberculin.

K. L. STOLL.

ON THE TREATMENT WITH ATROPINE IN ATROPHY OF THE OPTIC NERVE. P. I. GAPEEFF, Klin. Monatsbl. f. Augenh. **85:** 203 (Aug.) 1930.

In his treatment of atrophy of the optic nerve, the author employed the methods of Abadie and Hamburger. Abadie's retrobulbar injections of a 1:1,000 solution of atropine with simultaneous doses of atropine internally were replaced by intravenous and hypodermal injections, yielding satisfactory results according to Abadie and to Samkowsky. Hamburger injected amino glaucosan (an epinephrine substitute) below the conjunctiva near the equator of the eye. Gapeeff found that retrobulbar injections of atropine furnish equally good results as the intravenous and hypodermal; all of them cause a direct irritation of the fibers of the optic nerve by an active hyperemia. Hamburger's statement that weak solutions of amino glaucosan are effective in embolism of the central retinal artery as well as in atrophy of the optic nerve, was verified.

The results of neither method, however, were permanent, lasting not longer than a year. Then the vision appeared to be the same, or even less, than it had been at the beginning of the treatment. A second course of injections of atropine produced no favorable results.

K. L. STOLL.

A NEW THERAPY IN FILAMENTOUS KERATITIS. SCHALL, Klin. Monatsbl. f. Augenh. **85:** 406 (Sept.) 1930.

In all of his ten cases, when examined with Schirmer's test, Schall found the affected eye more dry than the other. Convinced that the lacrimation plays a rôle in filamentous keratitis, he used roentgen treatment. The eyes became more moist, the filaments and the disturbing sensation of dryness in the eyes disappeared after one treatment. A recurrence, noticed in just one of the ten cases after a lapse of one year, subsided after a second treatment. After protecting the globe, the lacrimal gland was exposed on an average for eight minutes from below and medially, and for nine minutes from above and laterally. One half of one skin erythema dose (unit skin dose) was used in eight cases and one unit skin dose in two of them.

K. L. STOLL.

Society Transactions

EDITED BY DR. GEORGE S. DERBY

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

W. F. C. STEINBUGLER, M.D., *Secretary*

Jan. 19, 1931

ERNEST F. KRUG, M.D., *in the Chair*

MEDULLATED NERVE FIBERS ASSOCIATED WITH CHOROIDITIS. DR. MILTON L. BERLINER.

This article will be published in full in a later issue of the ARCHIVES.

APPARENT CURE OF SEROUS DETACHMENT FOLLOWING THE GONIN OPERATION. DR. JULIUS WOLFF.

J. P., a woman, aged 41, was admitted to Mount Sinai Hospital on March 27, 1930, with the history of having been in an automobile accident two months before. The left side of her face struck the steering wheel and she was unconscious for about an hour. Following this accident she noticed that the vision of the left eye was gradually diminishing. At the time of admission, the right eye was normal; in the left eye the anterior chamber was deep, the pupil round and the lens clear, and there were some vitreous opacities. There was a large serous detachment in the upper part of the fundus which came close to the posterior surface of the lens. It overhung the upper part of the disk and macula. There was a slight detachment in the lower nasal quadrant, and a large reddish V-shaped tear was visible slightly to the nasal side of the outer meridian and about 12 mm. behind the corneal limbus. Vision was reduced to 10/200 with correction. Transillumination was negative, tension low and the visual field absent in the lower half. On March 27, a scleral puncture with the electrocautery was performed. A curved conjunctival incision was made about 8 mm. from the limbus and a conjunctival flap turned back, exposing the sclera at an area corresponding to the tear. When the puncture was made, a considerable quantity of subretinal fluid escaped. The cautery point was introduced four or five times in different directions and kept there for about a second. The flap was then sewed back into place. Examination with the ophthalmoscope showed a large blanched area around the tear and proved that the cautery had struck the proper point. The disk was now clearly visible and the retina apparently back in place. Recovery was uneventful. A week after operation vision was 15/40 with correction, and the tension still slightly subnormal. The patient was discharged four weeks after the operation. At the time of the last examination, December 16, vision was 15/20, the visual field showing no limitation or scotoma.

DISCUSSION

DR. ERNEST WALDSTEIN: I think that Dr. Wolff has been modest in describing his case as an apparent cure. If a permanent cure can be obtained by operation, evidently these traumatic cases give better results than the myopic cases. In the latter one cannot remedy the pathologic condition responsible for the detachment. Whether one holds to either of the two old theories—Leber-Nordenson's shrinking and pulling of preretinal or vitreous bands, or subretinal exudation—or whether one subscribes to the modern aspect of the problem voiced by Vogt—the formation of cystic cavities in the overextended retina and rupture of these cavities with a consequent detachment—no one will contend that Gonin's operation will do away with these causative pathologic changes. The problem has not yet been settled as to how many of the cases reported lately as cured will show a new detachment in the course of time. Conditions are absolutely different in traumatic cases like Dr. Wolff's, and their prognosis seems good.

DR. MARK J. SCHOENBERG: I should like to congratulate Dr. Wolff for the excellent result. Such results are not seen every day. There are only a few patients who do well following the Gonin operation, namely, those who present the real indications for the operation. We do not know fully what the indications are for the Gonin operation. One important thing in this case was that the detachment was mainly on the nasal side, so that the subretinal fluid had a chance to extend down nasally instead of to the temporal side, when it would have involved the macular area. Another important thing is that the detachment was due to trauma. I should prefer to call it a traumatic rather than a serous detachment. This was a case in which the Gonin operation was really indicated.

The fundus presents an interesting detail. One sees a delicate line of pigmentation extending across the upper half of the fundus from about 10 to 2 o'clock. This is the line of pigmentation that sometimes takes place in detachments of the retina which have healed spontaneously. In such cases this line acts as a barrier to the further extension of the detachment. Theoretically it would be interesting to speculate whether this patient would have recovered without an operation. Perhaps she might not have shown the progress expected in an ordinary detachment of the retina on account of the line of pigmentation. I fail to see how that line is the result of the Gonin operation. Of course, the cauterization did something to produce a plastic reaction in the choroid which was salutary to the retinal tear.

There is one more point—the condition of the fields. Though these patients appear to have a normal field in examination by the ordinary methods, it is impossible for the field to be normal in an eye in which there is a reattached retina after a Gonin operation.

DR. WOLFF: As to the likelihood of a spontaneous cure, I do not think it possible, because the condition had been progressive up to the time that I saw it, and the injury had taken place seven weeks before the operation. I do not think that it would have cleared up even with rest.

As far as the field of vision is concerned, the scar is so far peripheral that I do not see how it could cause much contraction of the field. I

have not ascertained whether there is a slight reduction of the field for colors, but there is no marked contraction for white objects 0.5 cm. in diameter.

It was interesting to observe that there was improvement after the operation; that whereas the retina in the main was back in place immediately afterward there still were a number of separate, narrow linear folds, detached from each other in different parts of the fundus; these gradually disappeared during the process of healing.

Melanoma of the Conjunctiva. Dr. James W. Smith.

A patient showing a recurrent pigmented nevus was presented before the Section in October, 1930. The patient was operated on at the Post-Graduate Hospital on October 18, and subsequently received three radium treatments at weekly intervals. The cosmetic result (shown by a lantern slide) was satisfactory. The pathologic report was pigmented nevus showing malignant activity; recurrence was to be expected. These recurrent pigmented tumors of the conjunctiva are of epithelial origin and should be classified as carcinomas. Ewing considers these tumors as melanoma.

DISCUSSION

Dr. Clyde McDannald: It is interesting to know what to do with this type of patient. Nine years ago, I showed such a case here at the Academy. I have not seen the patient until the past year, and until a year ago there had been no recurrence. When first examined he had normal vision, and I excised the melanotic growth; afterward he was subjected to radium treatment, and until a year ago there had been no recurrence of the growth.

Total Ectasia of the Sclera. Dr. James W. Smith.

This case had been presented before the Section in January, 1930, just prior to enucleation. A man, aged 34, had sustained a penetrating wound of the left eye at the age of 6, and had received treatment at the New York Eye and Ear Infirmary. An operation, presumably an iridectomy, was performed when he was 10. There was total ectasia of the sclera, and the eye measured 36 by 30 by 30 mm. The microscopic report showed secondary glaucoma, total keratectasia and sclerectasia, peripheral anterior synechiae of the iris, complicated cataract, atrophy of the ciliary body and cupping of the disk.

Microscopic Demonstration of Tissue Formations on the Optic Nerve Head. Dr. Bernard Samuels.

Normally the pit of the nerve head contains a loosely meshed tissue composed of glial cells with a few connective tissue fibers. Occasionally this formation is so rarefied that small groups of cells stand out like translucent flakes in front of the nerve head, suspended by threads too delicate to be seen with the ophthalmoscope.

There is often confusion concerning the hyaloid artery. Remnants of this vessel usually spring from the nasal crest of the excavation and not from the bottom. At times a delicate strand projects into the vitreous, which may or may not be covered with glial cells. The con-

nective tissue wall of the artery may entirely disappear, leaving a heap of glial cells seen clinically as a glistening spur on the nasal side, in the horizontal meridian.

The opaque white area that sometimes obscures the blood vessels in normal eyes as they emerge from the pit represents connective tissue. On the other hand, transparent or translucent membranes in the periphery of the nerve head are invariably made up of glial cells. These membranes have a great tendency to detach, forming vesicles. They seldom extend much beyond the margin of the disk.

Under pathologic conditions, new tissue readily forms on the nerve head, because there is present a rather raw surface, containing many capillaries. This tissue may take the form of membranes, strands or clumps of cells. Both the glial and the connective tissue elements have the property of proliferating under irritation. In inflammations of low grade, the glial element is apt to multiply. In more severe irritation, the connective tissue proliferates. In particular cases both proliferate. An extensive recession of the cribriform fascia may be concealed from view by a voluminous mass of new formation. With the ophthalmoscope one sees the surface of such a mass. In pathologic excavations the adjoining retina may be dragged into the excavation, partially filling it out.

A knowledge of the microscopy of these various tissues, both congenital and acquired, should enable one to differentiate them clinically, with a considerable degree of certainty.

STEREOSCOPIC PHOTOGRAPHIC DEMONSTRATION OF TISSUE FORMATIONS ON THE OPTIC NERVE HEAD. DR. ARTHUR J. BEDELL.

The demonstration followed the plan that Dr. Samuels outlined, starting with physiologic variations and closing with pathologic ones. The first photograph showed a reflex from the vitreous. The remnants of the hyaloid canal may be grouped into three classes: a fluffy mass, a distinct glistening membrane and a tubular structure. The next photographs showed variations in the membrane overlying the disk; some of these were small white flecks and others almost covered the disk. The second group presented variations from a thin, glasslike, transparent, diamond-shaped vesicle to a thick membranous form that extended beyond the edge of the disk.

Two pathologic exudates were demonstrated to show that in the physiologic form the blood vessels are unchanged, but that in the pathologic conditions they are decidedly contracted. Several illustrations of retinitis proliferans seemed to prove that when remnants of Cloquet's canal are present, inflammation makes them visible. A few photographs showed that Cloquet's canal can be definitely separated from the proliferating layer and that the canal may be a small, tubular knob at the point of bifurcation of the vessels, may cover most of the nerve head or may be ampulliform with a tubular formation extending into the vitreous.

A photograph of a choked disk was exhibited as an example of vascularized tissue on top of a swollen nerve head. The same eye was shown after operation, with the resulting connective tissue film extending beyond the edges of the disk.

An optic neuritis with considerable exudate was shown, both before and after the membrane developed over the disk. The difference between physiologic and pathologic membranes is that the former usually has a more definite border than the latter. This is to be taken into consideration with the rest of the picture of the fundus.

The end-result in a case of pernicious anemia showed the entire arterial tree with a mass of tissue filling in the central excavation.

Two cases of glaucoma were presented to show the filling in of the central excavation with newly formed tissue, just as Dr. Samuels demonstrated with the slides of pathologic conditions.

Two medullated nerve sheaths were shown. Almost all types of tissue formations can be distinguished by the careful use of the ordinary ophthalmoscope. Some, however, can be diagnosed only with the stereoscopic ophthalmoscope, and a small percentage can be positively differentiated only after the study of stereoscopic photographs. The stereoscopic photographs showed the membranes that Dr. Samuels carefully explained in his pathologic demonstration and also that when Cloquet's canal is present it becomes visible as a result of intra-ocular inflammation.

DISCUSSION

DR. LAURENCE D. REDWAY: I think that these stereoscopic photographs of the fundus probably represent about the highest technical achievement that I have seen. Few ophthalmologists who have not gone through the tortures of working up a technic that will present, with the startling clarity and stereoscopic objectivity of these photographs, the extremely diaphanous structures that Dr. Bedell has demonstrated with such certainty have any conception of the high degree of technical perfection required. I think that no one, least of all myself, can adequately express the indebtedness which the medical profession owes to Dr. Bedell for the nice accuracy and the extreme technical certainty of the work that he has shown here and has also presented in his various published reports.

DR. ARNOLD KNAPP: I cannot add anything except to say that we are indebted to Dr. Bedell for his excellent pictures. I think that most of us are better able to discuss Dr. Samuels' part of the paper than Dr. Bedell's; I should like to ask Dr. Samuels if he will state the exact significance of this membrane in front of the optic nerve head, and, if there is any truth in the statement that there is an excretory channel from the vitreous by way of the optic nerve, what happens to this excretory channel in the presence of these membranous formations.

DR. SAMUELS: To answer Dr. Knapp's first question about the significance of these tissues, I think that the slides bring out particularly that the white area seen in the center of the optic nerve is connective tissue, and that the sharply defined and translucent tissues seen in the periphery are neuroglia. The little plaque seen in physiologic excavation which looks like absorbent cotton consists of glial cells and connective tissue combined, but mostly glial cells.

Concerning Dr. Knapp's second question, I have often thought about that myself. The lymph passages, through which the fluid leaves the eye and goes to the brain when the nerve is covered with exudate or

tissue, must be interrupted. This of itself would disturb the circulation and make the fluids within the eye all the more toxic.

DR. BEDELL: Before closing I should like to ask Dr. Samuels to comment on the theory that Cloquet's canal becomes more evident in inflammation.

DR. CONRAD BERENS: Does Dr. Samuels know of any experiments on living human eyes which prove that the intra-ocular fluids pass out of the eyeball by way of the optic nerve. The experiments by Nuel and Benoit did not prove this point.

DR. SAMUELS: Dr. Bedell's question brings up a pleasant remembrance. When I saw Professor Fuchs last summer he remarked that the older he grew the more he seemed to see it demonstrated that Cloquet's canal is really present, and that the more one studies the eye, the more apparent it becomes. The microscope does not bring out Cloquet's canal, because in the vitreous there are certain tissues which do not stain, and one does not see them. I am greatly indebted to Dr. Bedell in that the camera brings out what the microscope does not show. I believe that these strands situated in the middle of the optic nerve are following the track of Cloquet's canal, as Dr. Bedell demonstrated.

In reply to Dr. Berens' question, I do not know of any experiment that has demonstrated the stoppage of the flow of lymph by pathologic tissue formed on the nerve head.

DR. ERNEST F. KRUG: I recently went over that subject thoroughly, and I found that no such experiment had ever been demonstrated.

March 16, 1931

ERNEST F. KRUG, M.D., *Chairman*

SURGICAL TREATMENT OF SQUINT

The evening was devoted to a symposium on the surgical treatment of squint, and the following papers were presented:

1. THE RECESSION OPERATION. DR. P. CHALMERS JAMESON (by invitation).

2. ADVANCEMENT AND OTHER SHORTENING OPERATIONS FOR CONCOMITANT SQUINT. DR. LUTHER C. PETER, Philadelphia (by invitation).

These articles will appear in full in a later issue of the ARCHIVES.

DISCUSSION

DR. WILLIAM THORNWALL DAVIS: (Dr. Davis is an enthusiastic supporter of Dr. Jameson's operation of recession. His test of a cure by operation consists in straight eyes, without glasses and with third degree fusion. In fifty patients operated on by the Jameson method alone, 84 per cent were cured. Of thirty-one cases in which either a Reese or a Worth procedure was added to the Jameson operation, twenty-seven patients were cured, and the result in one remains undecided. A case of right hyperphoria [hypertropia] of 40 degrees was

cured by 3 mm. recessions of the right superior and of the left inferior rectus muscles. The simplicity of the operation, with the slight damage to anatomic structures, is highly praised.

Operation to be performed when the patient is 4 years of age or younger is to be recommended, for the earlier the optic axes can be made parallel, the better the chance of a cure. In a large majority of cases in which operation is performed early immediate correction occurs, and no further measures are necessary. Squints, 90 per cent of which can be cured by the Jameson operation, should be cured during the preschool age. Glasses can thereby be avoided.

The degree of recession should be regulated by the thickness, width and secondary attachments of the muscle. One may expect a correction in the arc of from 3 to 5 degrees for each millimeter of recession of the median muscle. The recession of the muscle should not, however, be over 5 or 6 mm. Both eyes are bandaged for twenty-four hours, then until the fifth day only the eye on which operation was performed. The child can return to school on the sixth day. Catgut is the most desirable material for sutures.)

Dr. Conrad Berens: (Dr. Berens also believes that operation should be performed in the third or fourth year, when the deviation is so great that it is impossible to obtain results with orthoptic training. In this practice Duane's teaching is followed. The complete action of every ocular muscle should be preserved by conservative surgical intervention. One should hesitate to bury any suture material. Dr. Berens now seldom uses resection, since he believes that the underacting muscle is weakened by either resection or advancement. It is better to limit the action of the overacting muscle. Hypertropia and cyclotropia may result from improperly performed resections and advancements. The eyes are not bandaged for more than one day after recession or resection. The end-results of tenotomies are not only variable, but may be disastrous. Slight undercorrection is desirable in operations for recession. The internal rectus muscle is never receded more than 4.5 mm. in adults and 4 mm. in children, and the external rectus muscle, 5 mm. in adults and 4 mm. in children. In very young children with a high degree of convergent strabismus, a bilateral recession is preferred. The spasm of the internal recti, which usually exists and prevents fusion, is abolished by this method. In alternating divergent strabismus, recession of one or both external recti is performed before resection is performed. One should be cautious in performing an operation for recession on a muscle that shows any tendency to underaction. If one eye is amblyopic, it is preferable to operate on both eyes, unless there is serious overaction of the internal rectus or underaction of the external rectus muscle of the amblyopic eye. The effect of operations on the lateral recti should be gaged before an attempt is made to correct a vertical deviation. This is especially true in cases in which tenotomy of the inferior oblique seems to be indicated, for cyclotropia has followed tenotomy of the inferior oblique, preventing fusion in several cases.)

Dr. Ben Witt Key: (Dr. Key stressed the desirability of securing fusion, and he favors Dr. Jameson's operation of recession.)

Dr. Herbert W. Wootton: (In cases of convergent strabismus, Dr. Wootton favors double advancements as giving more permanent

results than the Jameson operation, which is apt to produce an under, rather than an over, effect.)

DR. LEWIS WEBB CRIGLER: (Dr. Crigler believes that in divergent strabismus due to tenotomy of one or both of the internal rectus muscles, the reattachment of the muscle will give a very favorable result.)

DR. P. CHALMERS JAMESON: The determination as to whether the primary operation should be for advancement or recession should be determined by the ophthalmologist's preoperative computation, based on objective tests of existing conditions. When the necessity of adjustment points to correction of a contracture of a tense, unyielding muscle on the opposing side, to place the emphasis of operation on advancement is to invite destabilization of the corrective result. In a case of this kind, advancement may not be necessary to secure perfect correction. In operations in this vicinity, the popularity of the exsection of Reese or similar procedures, however, is attributable to the fact that they lend themselves to preserving the natural insertion of the muscle, and that with the moderate effect obtainable, they make for a well balanced, combined procedure whereby, when required, neither the exsection nor the recession is overemphasized, and consequently suture tension is also balanced. Operations of the Worth type are of great value, especially when a maximum effect is desired; if too great an effect is secured, there may be a limitation of motion.

DR. LUTHER C. PETER: The best policy is to resort to the shortening operation first, and to use the recession as a supplementary procedure. Early operation is most important. Amblyopia exanopsia can be corrected by treatment. The monocular type of squint of moderate degree will spring into parallelism just as soon as the faculty of fusion is aroused, and one can then develop single binocular vision.

ROYAL SOCIETY OF MEDICINE, LONDON, SECTION OF OPHTHALMOLOGY

H. DICKINSON, *Reporter*

Clinical Meeting, March 13, 1931

MR. ELMORE BREWERTON, F.R.C.S., *President, in the Chair*

TUMOR OF THE IRIS. MR. LESLIE PATON.

(A man with tumor of the iris was shown. Ten days before presentation, the case seemed too dangerous to let alone. As the eye had 6/5 vision, the exhibitor was unwilling to excise it. He regarded the growth as sarcoma, and determined to try the effect of radium. Most members who saw it thought that it was not inflammatory.)

DISCUSSION

MR. ELMORE BREWERTON: I am satisfied that it is a new growth. If radium therapy fails, the question is whether or not an iridectomy should be performed to settle the diagnosis.

GLIOMA OF THE RETINA. MR. R. FOSTER MOORE.

(The left eye of a boy was removed because of glioma of the retina when he was 5 months old. His brother had had glioma and both eyes had been removed; in spite of this treatment he died. In the present case a radon seed was placed in the growth, which then started to disappear. The patient was shown to the Section the following month, and he was kept under observation. In January the condition was stationary. A second seed was inserted in April, 1930, and was lost in the eyeball, but was eventually recovered and fixed in position, no damage having been done. There was now a recurrence.)

PROPTOSIS. MR. R. A. GREEVES.

(In 1925, a case of proptosis was much the same as at present; there was fairly good vision. The conjunctival vessels were injected. The case was diagnosed hemangioma of the orbit.)

KRUKENBERG'S SPINDLE. MR. R. A. GREEVES.

(In a girl with Krukenberg's spindle the oval line of pigment was in the posterior layers of the cornea. In some cases of this kind the pigmentation is congenital, as in this case. It can, however, be acquired. It had been seen to develop in a woman aged 62.)

RETINAL MOLES. MR. R. A. GREEVES.

(A boy with retinal moles was shown. These growths are not common, but they are not of great clinical importance. They were not considered malignant in the present case, but were diagnosed as melanomas of the pigment epithelium.)

FAMILIAL MACULAR DEGENERATION. MR. R. A. GREEVES.

(Two girls with familial macular degeneration were shown. The sight of one, aged 18, was good until her tenth year, when it began to fail. Now it was 3/60 in each eye. The other was 11 years of age, and had had good sight until eighteen months before. Now vision was 6/36 in each eye.)

CATARACT AFTER AN ELECTRIC FLASH. MR. M. H. WHITING.

(In a man, aged 46, cataract had developed after an electric flash. When he was first seen, three days after the flash, there was considerable spasm and color phobia. The cornea did not seem to have been much injured. Vision was 6/12 in the right eye and 6/9 in the left, and later improved.)

CUPPED DISKS AND BINASAL HEMIANOPIA. MR. M. H. WHITING.

(A man with cupped disks and binasal hemianopia had been treated for syphilitic meningitis. The cupping did not extend over the whole area of the disk. There was a ringed scotoma which merged into the nasal defect. The hemianopia may have been due to unusual glaucom-

atous infection. The condition of the fields was considered due to thickened carotid arteries, or to thickened meninges pressing on the side of the chiasm.)

IRIDOCYCLITIS. MR. M. H. WHITING.

(A boy, aged 16, with iridocyclitis had enlarged superclavicular glands; the carotid arteries seemed to be enlarged. The Wassermann reaction was negative, and the blood count normal. A gland removed from the right side of the neck was typically tuberculous. The mediastinal glands seemed to be enlarged.)

DISCUSSION

MR. PENMAN: I would suggest ultraviolet treatment in the case of iridocyclitis.

SCLEROSING KERATITIS. MR. COLE MARSHALL.

(In a case of sclerosing keratitis the sclerosed mass was practically in the center of the cornea. Deep vessels entered it, as revealed by slit-lamp examination.

DISCUSSION

MR. ELMORE BREWERTON: I saw a similar case during the World War, in a boy, aged 19, involving only one eye. There seemed to be much pus in the substance of the cornea. At operation the mass was found between two layers of the cornea. After scraping there was practically complete recovery.

MR. O. G. MORGAN: This case does not correspond with the classic description of sclerosing keratitis. I do not think that operation will show any cavity.

RETINAL DETACHMENT. MR. H. NEAME.

(A case of retinal detachment was shown, in which at one time the exhibitor had lost hope of improving, as he had failed to bring about replacement of the retina. Further, the patient's attitude was not encouraging. The successful result now seen showed what patience and perseverance would accomplish.)

Book Reviews

AN ATLAS OF STEREO-PHOTOGRAPHS OF THE ANTERIOR SEGMENT OF THE EYE. Second series. By ROBERT VON DER HEYDT and HARRY S. GRADLE. Published by the authors, Chicago, 1931.

This series of fifty stereophotographs of patients, with descriptions and a clinical history of each, continues the previous series published in 1927. The photographs were made with the Drüner camera with arc-lamp illumination, and although not in color, the choice of angle, magnification and elimination of reflexes has been arranged so successfully that the absence of color is hardly missed. The cases included are of conditions not shown in the first series and fall into three groups. There are a number of rare conditions, such as embryotoxon, ectopia lentis, hypertrophy of the upper half of the iris, cataracta neurodermatica, rosacea keratitis, coloboma of the lid, metastatic carcinoma of the iris, microcoria and essential atrophy of the iris. While such photographs will not be used in the teaching of undergraduates, in many cases they will offer the ophthalmologist a first view of certain conditions that has almost the same value and interest as the observation of such cases in the material of a large clinic. Such cases, which would otherwise present puzzling problems when seen for the first time, will at once be recognized and understood, with the memory of these pictures in mind. A second type of case is represented by a number of acute inflammatory or traumatic conditions which are seldom illustrated in texts and many of which have perhaps never before been shown in photographs. Such are the cases of a burn of the cornea caused by a curling iron, copper wire in the iris and lens, a glass splinter on the iris, pediculosis of the lashes, dendritic ulcer, subconjunctival scleral rupture with expulsion of the lens, steel in the lens and perforation of the cornea with traumatic cataract. Then there are a number of common conditions which lend themselves especially to stereophotography, such as trachoma, vernal conjunctivitis, phlyctenule, sclerosing keratitis, epibulbar sarcoma and sarcoma of the ciliary body. The superiority of such stereophotographs to the usual illustrations in textbooks, with their absence of relief and frequently misleading color reproduction, is seen by comparing the pictures of trachoma and vernal catarrh with those in almost any book. In these photographs one may look through the pupil and see the edge of the ectopic lens in its place behind the iris, and in one picture a tumor of the ciliary body may be seen through the pupil.

The description of each photograph includes the essential points in history and diagnosis and often the treatment and result. In these accounts the reader is given the benefit of the authors' careful study of most cases with the slit-lamp, so that details that would escape many observers are brought out in their pathologic significance. This text gives the series an interest such as could be surpassed only by an actual clinic on the same cases conducted by physicians equally versed in their subject. The value of such a series for graduate and undergraduate teaching and for reference by the finished ophthalmologist can hardly be overestimated.

SANFORD R. GIFFORD.

PRINCIPLES AND PRACTICE OF PERIMETRY, By DR. LUTHER C. PETER. Third edition. Price, $4.50. Pp. 315, with 199 illustrations, 5 in color. Philadelphia: Lea & Febiger, 1931.

The third edition of this justly popular book will be welcomed by all who are especially interested in this important branch of ophthalmology. The book and its author are too well known to warrant an extensive review. It is sufficient to say that this edition has been thoroughly revised and brought up to date in every respect. The general arrangement has not been changed, but many pages of new text and numerous illustrations have been added. Quoting from the preface, the author says: "In a final analysis, the greatest change in this edition will be found in the plan of recording fields by the more correct anatomic or physiologic method . . . the author has the courage of his convictions to commend to his confrères a readjustment to the method which is correct, easy for the student to grasp," etc. This is, without question, a wise step, but there are many who will not consider it a great innovation and will wonder why it was not taken before. This is the method of field taking that was used and taught by Dr. Herman Knapp more than thirty years ago. His field charts were printed to conform to this method, and many of the ophthalmologists trained at the Knapp Hospital during the past thirty-five years never learned any other method. An appendix describes the use of the perimeter in the study of the field of monocular fixation, in measuring the angle of squint, in measuring the angle kappa, in the study of amblyopia ex anopsia, in the charting of diplopia and in the location of foreign bodies.

A. H. THOMASSON.

THREATENING SHADOWS. By VICTOR VECKI. Price, $2.50. Pp. 262. Boston: The Stratford Company, 1931.

Dr. Vecki has written a novel in which glaucoma is both the villain of the dramatis personae and the deus ex machina of a rather improbable and unbelievable plot.

Fault cannot be found with the descriptions of the early and late symptoms of glaucoma and the tragic consequences that may result from consulting optometrists and physicians who deal mostly with diseases of the ears, nose and throat and only occasionally with diseases of the eyes. Dr. Vecki's moral is so plainly stated that even the general reader should profit from perusing his tale; however, the necessity of sprinkling the pages of his book with the names of outstanding ophthalmologists and, in addition, supplying the surgeon who operated on his hero with the same name and the same home city as a well known American ophthalmologist is questionable.

Judged in its entirety, there is little to be said for either the story or the style. The plot is so poorly constructed that it has a decided tendency to creak, and the style bears an amazing similarity to that of "True Stories," with its extravagant descriptions, flowery language and improbable situations.

Whether or not an author desires to have his story teach as well as entertain is relatively unimportant, but, if such is his intention, it is most essential that his characters be so delineated and his portrayal of

human nature, passions, emotions and ambitions so accurate that he may be said to have held up a mirror to life and perpetuated the image by the magic of his pen.

W. F. DUGGAN.

PROCEEDINGS OF THE ALL-INDIA OPHTHALMOLOGICAL SOCIETY. Volume 1. Pp. 107. Madras, India: The Huxley Press, 1930.

The All-India Ophthalmological Society was recently formed and has a membership of about sixty; this volume reports the proceedings of the first meeting. The contributions cover a wide field. There are articles on infections of the eye in leprosy, on spring catarrh and on the geographic distribution of trachoma in India. Cases of tumors of the lid, corneal ulcers, Krukenberg's spindle, microphthalmia, retrobulbar neuritis and diseases of the paranasal sinuses were reported. The final communication, which is of rather more than usual interest, deals with surgical intervention on the eye in ancient India.

This new publication is welcome, and as the membership of its sponsoring society increases, it should have a permanent place among the ophthalmological annuals.

G. M. BRUCE.

Directory of Ophthalmologic Societies *

FOREIGN

British Medical Association, Section on Ophthalmology

President: Mr. E. E. Maddox, Glenartney, Poole Road, Bournemouth, England.
Place: Eastbourne. Time: July 22-24, 1931.

Oxford Ophthalmological Congress

Master: Dr. A. B. Cridland, Salisbury House, Chapel Ash, Wolverhampton, England.
Secretary: Dr. C. G. Russ-Wood, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 8-11, 1931.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 Avenue de La Motte Picquet, Paris 7è.

NATIONAL

American Medical Association, Section on Ophthalmologgy

Chairman: Dr. George F. Suker, 25 E. Washington St., Chicago.
Secretary: Dr. William C. Finnoff, Imperial Bldg., Denver.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. F. Barnhill, Miami Beach, Fla.
President-Elect: Dr. S. Hanford McKee, 1528 Crescent St., Montreal, Canada.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: French Lick, Indiana. Time: Sept. 14-19, 1931.

American Ophthalmological Society

President: Dr. Arnold Knapp, 10 E. 54th St., New York.
Secretary: Dr. Emory Hill, Professional Bldg., Richmond, Va.

SECTIONAL

New England Ophthalmological Society

President: Dr. S. Judd Beach, 704 Congress St., Portland, Me.
Secretary-Treasurer: Dr. E. B. Dunphy, 520 Commonwealth Ave., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Chester H. Bowers, 1136 W. 6th St., Los Angeles.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Albert E. Hillis, 1115 Pacific Ave., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, 806 Cobb Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Sioux Valley Eye and Ear Academy

President: Dr. Claude T. Uren, City National Bank Bldg., Omaha.
Secretary-Treasurer: Dr. Frederick H. Roost, 420 Trimble Bldg., Sioux City, Iowa.
Place: Fontanelle Hotel, Omaha. Time: November, 1931.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Fletcher D. Woodward, Box 162, University, Va.
Secretary: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: New Orleans. Time: November, 1931.

Southwestern Michigan Triological Society

President: Dr. Wilfrid Haughey, 65 W. Michigan Ave., Battle Creek.
Secretary: Dr. R. H. Fraser, Battle Creek Sanitarium, Battle Creek.
Time: Third Thursday of alternate months.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Ralph W. Danielson, 258 Metropolitan Bldg., Denver.
Place: First floor, Metropolitan Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive. Annual meeting in Denver, July 25, 1931.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Dorland Smith, 836 Myrtle Ave., Bridgeport.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: W. L. McDougall, 50 Whitehall St., S. W., Atlanta.
Secretary-Treasurer: Dr. William O. Martin, Jr., 412 Medical Arts Bldg., Atlanta.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. John W. Carmack, 23 E. Ohio St., Indianapolis.
Secretary: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. Gordon F. Harkness, 215 Main St., Davenport.
Secretary-Treasurer: Dr. W. F. Boiler, 105 E. Iowa Ave., Iowa City.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. John C. Brown, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Hendrie W. Grant, Lowry Bldg., St. Paul.

Montana Academy of Oto-Ophthalmology

President: Dr. L. H. Huber, Livingston.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Beeson, 232 W. De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. M. Hendershott, 193, 11th St., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

President: Dr. Raymond F. Hacking, 105 Waterman St., Providence.
Secretary: Dr. Herman A. Winkler, 224 Thayer St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

Utah Ophthalmological Society

President: Dr. Franklin H. Raley, 9 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. H. Leroy Smith, 1005 Medical Arts Bldg., Salt Lake City.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. Fletcher D. Woodward, Box 162, University.
Secretary-Treasurer: Dr. Henry Grant Preston, Harrisonburg.

West Virginia State Medical Association, Eye, Ear, Nose and Throat Section

President: Dr. S. S. Hall, Fairmont.
Secretary: Dr. G. A. Smith, Montgomery.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. J. Wallace Hurff, 86 Washington St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Academy of Medicine of Toronto, Section of Ophthalmology

Chairman: Dr. P. J. F. Houston, 34 Hurndale Ave., Toronto.
Secretary: Dr. Alexander E. MacDonald, 151 Bloor St., W., Toronto.
Time: First Monday of winter months.

Atlanta Academy of Ophthalmology and Oto-Laryngology

President: Dr. John R. Childs, 45 Edgewood Ave., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., Medical Arts Bldg., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St., N. E. Time: 8 p. m., last Thursday of each month.

Baltimore Medical Society. Section on Ophthalmology

Chairman: Dr. Angus Lloyd MacLean, Johns Hopkins Hospital, Baltimore.
Secretary: Dr. Henry F. Graff, 513 N. Charles St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. John N. Evans, 23 Schermerhorn St., Brooklyn.
Secretary: Dr. Michael J. Buonaguro, 589 Lorimer St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday of February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. A. F. Luhr, 40 W. North Ave., Buffalo.
Secretary-Treasurer: Dr. Thurber Le-Win, 112 Linwood Ave., Buffalo.

Chicago Ophthalmological Society

President: Dr. Harry S. Gradle, 58 E. Washington St., Chicago.
Secretary: Dr. Richard C. Gamble, 30 N. Michigan Ave., Chicago.
Place: Medical and Dental Arts Club. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. William V. Mullin, 9204 Euclid Ave., Cleveland.
Secretary: Dr. H. C. Rosenberger, 2064 E. 9th St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. E. Burner, Guardian Bldg., Cleveland.
Secretary: Dr. M. P. Motto, Rose Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Maxwell Langdon, 1530 Locust St., Philadephia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. A. M. Hauer, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. Albert D. Frost, 681 E. Broad St., Columbus, Ohio.
Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. L. M. Sellers, 717 Pacific Ave., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, 717 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Parker Heath, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. G. G. Marshall, 122 West St. Rutland, Vt.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. J. J. Richardson, 606 Penn St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, 1304 Medical Arts Bldg., Forth Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. Claude C. Cody, 1306 Walker Ave., Houston, Texas.
Secretary: Dr. J. M. Robison, Eye, Ear, Nose and Throat Hospital, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. E. L. Lingeman, 241 N. Pennsylvania St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Secretary: Dr. O. S. Gilliland, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

President: Dr. Dean E. Godwin, Security Bldg., Long Beach, Calif.
Secretary-Treasurer: Dr. Ferris Arnold, Security Bldg., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

Los Angeles County Medical Society, Section on Ophthalmology and Oto-Laryngology

President: Dr. Eugene R. Lewis, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Lutheran Hospital, Assembly Room. Time: 8 p. m., first Monday of each month from October to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. James A. Flynn, 1511 Rhode Island Ave., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month.

Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. Herbert F. Wolters, 130 Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 324 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Hilliard Wood, 700 Church St., Nashville, Tenn.
Secretary-Treasurer: Dr. H. C. Smith, Medical Arts Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

New Orleans Ophthalmological and Otological Society

President: Dr. W. R. Buffington, 211 Camp St., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Mark J. Schoenberg, 1160 Park Ave., New York.
Secretary: Dr. Algernon B. Reese, 50 W. 52nd St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. George B. Potter, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 425 Aquila Court, Omaha.
Place: Medical Tea Room. Time: 5:15 and 7:00 p. m., third Wednesday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. Clyde Heatly, 11 N. Goodman St., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 S. Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Assn., 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. Emanuel U. Wallerstein, Professional Bldg., Richmond, Va.
Secretary: Dr. William R. Weisiger, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Martin H. Post, 508 N. Grand Blvd., St. Louis.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: St. Louis or Washington University Cafeteria.
Time: 6:30 p. m., fourth Friday of each month from October to April, inclusive.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. T. J. Walthall, 728 Main Ave., San Antonio, Texas.
Secretary-Treasurer: Dr. E. D. Dumas, 425 Medical Arts Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. W. F. Swett, 693 Sutter St., San Francisco.
Secretary: Dr. Robert C. Martin, 384 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Third Tuesday of every month except May, June, July and December.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Paul A. Remington, Old National Bank Bldg., Spokane, Wash.
Secretary: Dr. Louis A. Parsell, Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. Searle B. Marlow, State Tower Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

INDEX TO VOLUME 5

The asterisk (*) preceding the page number indicates an original article in the Archives. Subject entries are made for all articles. Author entries are made for original articles and for articles in society transactions. Book Reviews, Obituaries and Society Transactions are indexed under these headings in their alphabetical order under the letters B, O, and S respectively.

PAGE

Abnormalities: See also under names of diseases and organs
another case of Marcus Gunn's phenomenon 970
congenital anophthalmos with orbitopalpebral cyst..... *884
familial congenital aniridia..... 297
family affected with keratoconus and anterior polar cataract..... 969
interpretation of a complex of congenital anomalies as caused by fixation of fetal conditions 129
persistence of hyaloid artery and canal of Cloquet..... 970
teratogenic ocular anomaly..... 132
Abraham, S. V.: Heterophorias; new test for vertical phorias, with observations on patients with presumably negative histories *766
Abscesses, multiple abscesses in both optic nerves caused by streptococcic sepsis... 659
Accommodation *1
for distance..... 820
investigation into effect on eyes of occupations involving close work..... 481
physiologic and clinical value of chromatic aberrations of eye..... 479
weakness of..... *362
Adenocarcinoma of lacrimal gland..... 485
Adrenaline: See Suprarenal preparations
Agatston, S. A.: Unusual case of medullated nerve fibers with amblyopia..... 506
Albinos, implantation of dark substances into lids of albinos..... 655
Alcohol injections in spastic entropion.... 304
treatment of painful eyes with vision by means of orbital injection of moderately concentrated alcohol..... 985
Amblyopia: See Blindness
Amblyoscope, test types for estimating with Worth's amblyoscope the vision of malingerers *918
American Board for Ophthalmic Examinations.....646, 804, 967
Anesthesia, rectal narcosis in ophthalmic surgery 473
Angioma venosum of orbit..... 833
Aniridia: See under Iris
Anomalies: See Abnormalities; and under names of diseases and organs
Anophthalmos, congenital, with orbitopalpebral cyst..... *884
Apparatus: See also Instrument
Aqueous Humor, circulation of..... 835
drainage of intra-ocular fluids..... 480
formation of Ehrlich line..... 808
intraocular pressure and drainage of aqueous humor..... 818
particulate size of intravenously injected dyes in serum and aqueous..... 819
pathology of anterior chamber..... 969
Arachnodactylia: See under Fingers
Arachnoiditis, chiasmal syndrome produced by chronic local arachnoiditis; report of 8 cases.....*558

Arachnoiditis—Continued PAGE
chronic cisternal arachnoiditis producing symptoms of involvement of optic nerves and chiasm; pathology and results of operative treatment in 4 cases.....*334
Argyll Robertson Pupil: See under Pupil
Arteriosclerosis, significance of arteriosclerosis on retina, choroid and optic nerve in pathogenesis of retinitis albuminurica 141
Artery, embolism of central retinal artery.. 677
persistence of hyaloid artery and canal of Cloquet..... 970
treatment of embolism of central retinal artery 659
Aspergillus, two cases of granuloma invading orbit due to aspergillus..... 477
Astigmatism, contact glasses for high astigmatism 149
unaided vision of astigmatic eye..... 982
Atrophy, Optic: See under Nerve
Atropine, synergistic action of atropine and epinephrine on intrinsic muscles of eye.*212
treatment in atrophy of optic nerve..... 986
Automobile drivers, psycho-visual requirements 138
Azotemia: See under Blood

Bacterium granulosis in trachoma.....312, *527
Bag, an emergency kit for ophthalmic examinations and treatment..... 666
Barkan, H.: Squint; its physiopathology and surgical treatment.....*691
Barkan, O.: Squint; its physiopathology and surgical treatment.....*691
Beard, H.: Postcyclioplegic test.....*943
Beaumont, J. H.: Contact glasses for high astigmatism 149
Bedell, A. J.: Stereoscopic photographic demonstration of tissue formations on optic nerve head..... 991
Bjerrum, sensitive methods for detection of Bjerrum and other scotomas.....*224
Blaauw, W. E.: Allvar Gullstrand..... 294
Blastomycosis, intra-ocular.....*581
Blatt, N.: Weakness of accommodation...*362
Blepharochalasis; Blepharoplasty; Blepharospasm: See under Eyelid
Blindness, causes of blindness among Chinese 297
experimental study of quinine amblyopia. 135
unusual case of medullated nerve fibers with amblyopia..... 506
Blood, alkaline reserve of blood and intraocular tension..... 974
calcium in diabetic retinitis..... 309
cholesterol content in glaucomatous patients 808
experimental hyperazotemia and ocular changes 136
pressure, differentiation and significance of certain ophthalmoscopic pictures in hypertensive disease..... 811
sugar, relation between hyperglycemia and glycosuria in experimental diabetes and in clinical cases with ocular changes.. 135

Book Reviews:
Acta of the Japanese Ophthalmological Society, October, 1930..... 839
Administration Report of Government Ophthalmic Hospital, Madras, for Year 1929; R. E. Wright..... 683
Atlas of Stereo-Photographs of Anterior Segment of Eye; R. von der Heydt and H. S. Gradle..... 998

BOOK REVIEWS—Continued PAGE

Biomicroscopie du Cristallin; C. Duverger and E. Velter ... 154
Bulletin of the Neurological Institute of New York ... 841
Collected Reprints from Wilmer Ophthalmological Institute of Johns Hopkins University and Hospital. Volume 1, 1925-1929 ... 684
Glaukom. Handbuch der gesamten Augenheilkunde; A. Peters ... 320
Introduction a l'étude des hypertensions oculaire; G. Bonnefon ... 842
Kurzes Handbuch der Ophthalmologie; F. Schieck and A. Brückner ... 153
Lehrbuch und Atlas der spaltlampen Mikroskopie des lebendes Auges; A. Vogt ... 319
Moyens de protection des yeux exposés aux radiations ultraviolettes; A. Halphen ... 320
Principles and Practice of Perimetry; L. C. Peter ... 999
Proceedings of the All-India Ophthalmological Society ... 1000
Succès opératoires dans le traitement du décollement retinien; est-il indispensable d'obturer la déchirure; G. P. Sourdille. 318
Threatening Shadows; V. Vecki ... 999
Brain, complete bilateral congenital exterior ophthalmoplegia and double ptosis; bilateral cerebral cortical atrophy of frontal and parietal regions ... *15
tumor, importance of choked disk in diagnosis between epidemic encephalitis and cerebral tumor ... 305
tumor; progressive exophthalmia due to new growth in frontal lobe ... 654
tumors, operations and their results ... 476
tumors, ophthalmologic experiences in care of ... 474
tumors; vascular tumors of brain and spinal cord (neurologic standpoint) ... 316
tumors; vascular tumors of brain and spinal cord (ocular manifestations) ... 316
Brewerton: Entoptic phenomena ... 150
Bruce, G. M.: Retinoblastoma, its recognition when fundus oculi is obscured .. *890
Buphthalmia with facial naevus and allied conditions ... 137
Burch, F. E.: Operations on muscles, with special reference to tucking method ... 489
Burns; cysts of cornea after burn with chloroform ... 809

Caddy, A.: Case of keratitis ... 148
Calcium in relation to cataract ... 496
in relation to cataract; in vitro ... *856
in relation to cataract; in vivo ... *868
Canal of Cloquet: See Cloquet's Canal
of Schlemm: See Schlemm's Canal
Cancer: See also Sarcoma; Tumor; etc.
multiple epidermoid carcinoma of eye and lid ... *936
recurrent epidermoid carcinoma ... 671
Cardell, J. D.: Peculiar opacity of cornea .. 829
Castroviejo, R.: Pathology of chronic simple glaucoma ... *189
Cataract after an electric flash ... 996
calcium in relation to ... 496
calcium in relation to cataract; in vitro .. *856
calcium in relation to cataract; in vivo .. *868
chemical studies of lipids of normal animal lenses, cataractous human lenses and blood of patients with cataract ... *354
colored crystals on anterior surface of lens affected by senile cataract ... 653
electric cataract ... 302
extraction of cataract; report of a third hundred successive extractions in capsule after preliminary subluxation with capsule forceps ... *575
extraction of cataract with conjunctival bridge ... 679
family affected with keratoconus and anterior polar cataract ... 970

Cataract—Continued PAGE

frequency and shape of anterior axial "nahtpunktierung" and anterior axial embryonic cataract ... 139
from exposure to roentgen rays ... 681
intra-capsular cataract extraction at Moga, Punjab ... 975
intra-capsular cataract extraction, its present status ... *93
intra-capsular extraction of ... 976
leaf-shaped or rosette-shaped cataracts .. 303
lens capsule in intracapsular extraction of cataract ... 304
management and treatment of incipient cataract ... 139
operation ... 814
operation, modified Barraquer ... 498
operations in extreme old age ... 814
orange discoloration of anterior segment after unsuccessful cataract operation ... 976
pathology of human cataract; weight relations of human lenses ... 302
senile: use of parathyroid extract ... *754
short study of complications of cataract extraction in Egypt with some practical suggestions ... 653
test for retinal function in cataractous patients ... *636
traumatic zonular cataract ... 148
Catarrh, Spring: see Conjunctivitis
Celluloid leaves, implantation of dark substances into lids of albinos ... 655
Chauffeurs, psychovisual requirements of automobile drivers ... 138
Cherry-Red Spot: See under Macula
Chinese, causes of blindness among Chinese 297
Chloroform, cysts of cornea after burn with ... 809
Choked Disk: See Papilledema
Cholesterol content of blood in glaucomatous patients ... *808
crystals in subretinal fluid of an atypical retinal detachment ... 822
Choroid, routes of extra-ocular extension of melanosarcoma of ... 145
Choroiditis, retrobulbar neuritis masked by choroiditis and due to latent sinusitis .. 830
Christian's Syndrome: See under Diabetes Insipidus
Cilia in anterior and posterior chambers ... 652
Ciliary wound and hernia caused by bursting glass; recovery with conservation of eye ... 813
Cloquet, persistence of hyaloid artery and canal of Cloquet ... 970
Cochran, A. H., Jr.: Multiple epidermoid carcinoma of eye and lid ... *936
Recurrent epidermoid carcinoma ... 671
Cohen, M.: Infantile glaucoma with hypotony and complicated cataracts ... 678
Traumatic pulsating exophthalmos (postoperative) ... 834
Collins, E. T.: Vascular tumors of brain and spinal cord (ocular manifestations) 316
Color Blindness ... 679
detection of color blindness from a practical point of view ... 151
hereditary color blindness and changes in macula: case of total color blindness coupled with retinitis pigmentosa ... 130
Colorado Congress of Ophthalmology and Oto-Laryngology ... 967
Congress: See under Society
Conjunctiva, clinical and histologic picture of epithelial xerosis of conjunctiva ... 131
disturbances of sensibility of cornea and conjunctiva in xerosis and keratomalacia of adults; with contribution to explanation of genesis of these diseases ... *374
melanoma of ... 990
origin of malignant melanoma of tunica conjunctiva ... 146
pigmentation of conjunctiva in normal individuals and in cases of keratomalacia in adults ... 647

Conjunctiva—Continued PAGE
recurrent pigmented nevus of conjunctiva 505
sporotrichosis of bulbar conjunctiva.... 970
Conjunctivitis 678
oculoglandular tularemia (Parinaud's conjunctivitis) 470
spring catarrh and Hebra's prurigo..... 648
tarsal biomicroscopy in some types of.... 977
Contact glasses, case of keratoconus with Müller's contact lenses..... 672
for high astigmatism..... 149
worn for 6 years in case of keratoconus 471
Convulsive movements, mechanism of some convulsive movements of orbicularis and of face; manner of their removal.....*272
Corectopia: See under Pupil
Cornea: See also Keratitis: Keratoconjunctivitis; Keratomalacia; Keratoplasty
cysts of cornea after burn with chloroform 809
diseases in acquired syphilis..... 133
disturbances of sensibility of cornea and conjunctiva in xerosis and keratomalacia of adults; with contribution to explanation of genesis of these diseases *374
fistula of; tuberculous keratitis; repair.. 832
Krukenberg's spindle.....808, 996
marginal degeneration of.....132, 678
peculiar opacity of..... 829
pigmented network on posterior surface of cornea 297
transplantation of human cornea, report of case.....*789
trephining of cornea in removal of melanosarcoma of iris..... 979
ulcer; treatment of serpiginous ulcer of cornea by means of iontophoresis with ethyl hydrocuprein hydrochloride..... 133
Correction to "Cataract in diabetes and treatment with insulin" 4: 946, 1930... 287
Cowan, A.: Glasses; how should the ophthalmologist write his prescription? 667, *849
Retinal detachment; method of accurately localizing tears.....*760
Craig, W. McK.: Chiasmal syndrome produced by chronic local arachnoiditis; report of 8 cases.....*558
Cranium, exophthalmos associated with diabetes insipidus and large defects in bones of skull.....*161
Crystalline Lens: See Lens, crystalline
Crystalloids in human retina..... 969
Crystals, colored crystals on anterior surface of lens affected by senile cataract 653
Cunningham, J. F.: Massive exudate..... 149
Curtin, T. H.: Embolism of central retinal artery 677
Thrombosis of branch of central retinal vein 677
Cylindroma of orbit..... 485
Cyst, congenital anophthalmos with orbitopalpebral cyst.....*884
of cornea after burn with chloroform.... 809
of iris..... 833

Dacryo-Adenitis; Dacryocystitis; Dacryocystorhinostomy: See under Lacrimal Organs
"Dark-light test," reflex transmission of stimuli from one eye to other; "dark-light test" following neurectomy.....*261
Delaney, J. H.: Sympathetic ophthalmia; unassociated with perforation or rupture of eyeball.....*781
Derby, G. S.: Social service at Massachusetts Eye and Ear Infirmary..... 508
Diabetes, blood calcium in diabetic retinitis 309

Diabetes—Continued PAGE
early diabetic retinitis..... 149
insipidus, exophthalmos associated with diabetes insipidus and large defects in bones of skull.....*161
insipidus; xanthomatosis or lipoid histiocytosis; report of ocular observations in 2 cases of Christian's syndrome: a correlation with other ocular syndromes *29
relation between hyperglycemia and glycosuria in experimental diabetes and in clinical cases with ocular changes..... 135
Distichiasis: See under Eyelashes
Doggart, J. H.: Early diabetic retinitis.... 149
Marginal degeneration of cornea..... 678
Multiple foreign bodies in cornea..... 149
Recurrent vascular keratitis of unknown origin 831
Duane, A.: Accommodation..... *1
Binocular vision and projection.....*734
Duke University Medical School and Hospital, opening..... 966
Duke-Elder, W. S., delivers Howe lectures.. 127
Dust 805
Dyes, particulate size of intravenously injected dyes in serum and aqueous..... 819

Echinococcosis, extirpation of hydatid cysts of orbit by subaponeurotic orbitotomy.... 477
Edridge-Green, F. W.: Detection of color blindness from a practical point of view 151
Ehrlich line, formation of..... 808
Electric cataract..... 302
flash, cataract after an..... 996
shock, optic atrophy with retinal changes caused by high-tension current..... 658
Electrocoagulation of pterygia.....*732
Ellett, E. C.: Retinal detachment; review of some recent literature.....*784
Elliott's trephine operation—a variant..... 655
Ellis, Z. H.: Osseous tumors of orbit.....*449
Embolism of central retinal artery..... 677
of central retinal artery; treatment of... 659
Embryos, rosette formation in eyes of irradiated human embryos.....495, *591
Emerson, H.: Health of eyes in Philadelphia 314
Encephalitis, importance of choked disk in diagnosis between epidemic encephalitis and cerebral tumor..... 305
Enophthalmos, traumatic, origin of..... 817
Entoptic phenomena..... 150
Entropion, congenital entropion..... 648
injections of alcohol in spastic entropion. 304
Ephedrine and glaucoma..... 652
Episcleritis: See under Sclera
Epithelioma of meibomian gland..... 313
Esophoria; heterophorias, new test for vertical phorias with observations on patients with presumably negative histories *766
Ethyl hydrocuprein hydrochloride and iontophoresis in serpiginous ulcer of cornea 133
Exophthalmos associated with diabetes insipidus and large defects in bones of skull *161
intermittent, and its operative treatment.. 140
progressive, due to new growth in frontal lobe 654
pulsating, operative treatment of..... 656
traumatic pulsating exophthalmos (postoperative) 834
xanthomatosis or lipoid histiocytosis; 2 cases of Christian's syndrome..... *29
Eye: See also Abnormalities; Tension; Vision; and under names of special structures and diseases
arachnodactylism with especial consideration of ocular symptoms..... 136
cancer; multiple epidermoid carcinoma of eye and lid.....*936

Eye—Continued PAGE

differentiation and significance of certain ophthalmoscopic pictures in hypertensive disease ... 811
diseases, insulin therapy in ocular diseases ... 146
diseases of paranasal sinuses in relation to diseases of eye ... 488
diseases, treatment of eye conditions in India ... 663
enucleation; unusual complication in regular enucleation ... 137
existence of ocular center in midbrain and hindbrain ... 481
experimental hyperazotemia and ocular changes ... 136
experimental studies on development of eye; effect of substrate ("Unterlagerung") on heterotopic development of median and lateral strips of anterior end of neural plate of Amblystoma ... 807
focal infection, an etiologic factor in diseases of ... *893
Foreign body in: See Foreign Bodies
injuries, ciliary wound and hernia caused by bursting glass: recovery with conservation of eye ... 813
lesions caused by energy of emanating rays ... 972
lesions in septicemia ... *175
liver therapy in ocular lesions of true and pseudo-pernicious anemia ... 665
massive exudate ... 149
models illustrating development of normal eye and its malformations ... 647
Muscles: See Heterophoria; Muscles
muscles, functional synergy of mastication and elevation of upper eyelid ... 307
nose and throat in relation to orbital and ocular disease ... 307
of irradiated human embryos, rosette formation in ... 495
proptosis ... 996
proptosis as a diagnostic problem ... 834
rare forms of hereditary syphilis affecting eye alone ... 135
résumé of special inquiry on health of eyes in Philadelphia ... 314
shrunken stump ... 828
surgery; trial exercises and new procedures in ocular surgery with two keratomes ... 979
symptoms in a case of myasthenia with tumor of thymus ... 811
Tension: See Tension
Tuberculosis: See under Tuberculosis
vital staining of posterior segment of globe ... 818
Eyelash: See Cilia
Eyelids: See also Meibomian gland
blepharochalasis of lower lids ... 304
complete bilateral congenital exterior-ophthalmoplegia and double ptosis; bilateral cerebral cortical atrophy of frontal and parietal regions (encephalograms) ... *15
functional synergy of mastication and elevation of upper eyelid ... 307
implantation of dark substances into lids of albinos ... 655
multiple epidermoid carcinoma of eye and lid ... *936
palpebral complication in a case of Kaposi's sarcomatosis ... 977
primary syphilis of ... 139

Fabricant, N. D.: Eye in tuberculous patient ... *66
Face, mechanism of some convulsive movements of orbicularis and of face; manner of their removal ... *272
Feigenbaum, A.: Reflex transmission of stimuli from one eye to other; "dark-light test" following neurectomy ... *261

PAGE

Ferree, C. E.: Refraction for peripheral field of vision ... *717
Sensitive methods for detection of Bjerrum and other scotomas ... *224
Fingers, case of arachnodactylism, with especial consideration of ocular symptoms ... 136
Finnoff, W. C.: Bacterium granulosis in trachoma ... *527
Fistula of cornea; tuberculous keratitis; repair ... 832
Fleming, N.: Extraction of cataract with conjunctival bridge ... 679
Forceps, Schaaf forceps for removal of foreign bodies ... *802
Ford, R.: Retrobulbar neuritis masked by choroiditis and due to latent sinusitis ... 830
Foreign Body, cilia in anterior and posterior chambers ... 652
in upper conjunctival fornix ... 652
multiple foreign bodies in cornea ... 149
non-magnetisable metallic foreign bodies of cornea, with report of case ... 138
Schaaf forceps for removal of ... *802
technic of diascleral magnet operation ... 476
Frazier, C. H.: Surgical treatment of pituitary tumors ... 826
Frey, G.: Melanotic nevus of eye ... 504
Friedenwald, J. S.: Circulation of aqueous 835
Ocular lesions in septicemia ... *175
Friedman, B.: Test for retinal function in cataractous patients ... *636

Gifford, S. R.: Multiple myxoma of orbit; later note ... *445
Relation of paranasal sinuses to ocular disorders; especially to retrobulbar neuritis ... *276
Test types for estimating with Worth's amblyoscope the vision of malingerers. *918
Glasses: See also Contact Glasses
how should ophthalmologist write his prescriptions for glasses? ... 667, *849
prism, in early stages of concomitant strabismus ... 476
toric spectacles ... 482
Glaucoma ... 301
alkaline reserve of blood and intra-ocular tension ... 974
and ephedrine ... 652
cholesterol content of blood in glaucomatous patients ... 808
Elliot's trephine operation—a variant ... 655
exchange of fluid between blood and tissue in ... 812
infantile, with hypotony and complicated cataracts ... 678
iridencleisis in ... 813
modified Lagrange operation in ... 669
new operative procedure ... *634
operative treatment of ... *327
paracentral field in early glaucoma ... *601
pathology of chronic simple glaucoma ... *189
puncture of anterior chamber in ... 673
reflex transmission of stimuli from one eye to other; "dark-light test" following neurectomy ... *261
secondary, some phases of ... 651
secondary, with detached retina in both eyes ... *55
trephine operation; pressure and dirt in this operation, with new devices for control ... *517
with premenstrual exacerbations ... 812
Glioma, extension of glioma (retinoblastoma) into optic nerve ... *269
of retina ... 996
of retina, including results of studies with silver impregnations ... *920
Globus, J. H.: Tumors of quadrigeminate plate; clinico-anatomic study of 7 cases ... *418
Globus pallidus: See Lenticular Nucleus

PAGE

Glycosuria: See Urine, sugar
Goldenburg, M.: Eye in tuberculous patient *66
Goldstein, I.: Niemann-Pick's disease with cherry-red spots in macula.....*704
Ocular pathology of Niemann-Pick's disease with cherry-red spot in macula... 506
Rosette formation in eyes of irradiated human embryos.....495, *591
Gonin's Operation: See Retina, detachment
Gouterman, J. I.: Tay-Sachs-Schaeffer disease; review of disease and allied conditions 491
Grant, H. W.: Operations on muscles, with special reference to tucking method.... 489
Granuloma, two cases invading orbit due to aspergillus 477
Green, J.: Two per cent epinephrine solutions as substitutes for laevoglaucosan..*350
Greenwood, A.: Lattice keratitis; 5 cases in 1 family 497
Greeves, R. A.: Familial macular degeneration 996
Krukenberg's spindle..... 996
Proptosis 996
Retinal moles..... 996
Grinker, R. R.: Gliomas of retina, including results of studies with silver impregnations *920
Griscom, J. M.: Modified Lagrange operation in glaucoma..... 669
de Grosz, E.: Diseases of paranasal sinuses and their relations to disorders of eye.. 488
Operative treatment of glaucoma.....*327
Trachoma 501
Gunn phenomena: See Jaw-Winking phenomena

Halloway, T. B.: Ophthalmologic aspects of pituitary tumors..... 827
Hardy, C.: Refraction for peripheral field of vision *717
Hartgraves, H.: Synergistic action of atropine and epinephrine on intrinsic muscles of eye.....*212
Hathaway, W.: Health of eyes in Philadelphia 314
Heath, P.: Xanthomatosis or lipoid histiocytosis; report of ocular observations in 2 cases of Christian's syndrome: a correlation with other ocular syndromes... *29
Hemianopia, binasal..... 661
binasal, and cupped disks..... 996
two cases of homonymous hemianopia and hemianopic quadrant defect of cortical origin 306
Herpes and allied conditions..... 499
zoster ophthalmicus, unusual case..... 978
Heterophoria: See also Strabismus
new test for vertical phorias, with observations on patients with presumably negative histories.....*766
Heuer, G. J.: Chronic cisternal arachnoiditis producing symptoms of involvement of optic nerves and chiasm; pathology and results of operative treatment in 4 cases.....*334
Hill, H. F.: Sporothrix infection of eye and adnexa 494
Holth, S.: "Subconjunctival tunneling".... 287
Hory, J. S.: Angioma venosum of orbit..... 833
Hospital care for people of moderate means, 10 month demonstration..... 967
Howe Laboratory of Ophthalmology..... 804
lectures delivered by W. S. Duke-Elder.. 127
Hyaloid canal: See under Vitreous
Hydatid disease: See Echinococcosis
Hydrogen, behavior of vitreous under different hydrogen and hydroxyl ion concentrations; study in vitro.....*903
Hydrophthalmos: See Buphthalmia
Hydroxyl ion, behavior of vitreous under different hydrogen and hydroxyl ion concentrations *903
Hyperglycemia: See Blood sugar
Hypertension: See Blood pressure; Tension
Hypophysis: See Pituitary Body

PAGE

Idiocy, amaurotic, distribution of lipoid in Niemann-Pick's disease associated with amaurotic family idiocy..... 815
amaurotic; ocular pathology of Niemann-Pick's disease with cherry-red spot in macula 506
Infection, focal, an etiologic factor in eye diseases *893
focal, episcleritis due to..... 828
Instrument case, an emergency kit for ophthalmic examinations and treatment 666
resistance pupilloscope..... 974
Schaaf's forceps for removal of foreign bodies *802
trial exercises and new procedures in ocular surgery with two keratomes..... 979
Insulin therapy in ocular diseases..... 146
Iontophoresis and ethyl hydrocuprein hydrochloride in serpiginous ulcer of cornea 133
Iridencleisis 287, 813
Iridocyclitis 997
congenital 487
tuberculous, diagnosis..... 968
Iris, case of familial congenital aniridia... 297
case of ring sarcoma of..... 144
cyst of..... 833
local absence of stroma of iris..... 148
primary sarcoma of iris; removal by iridectomy; no recurrence in 3½ years...*219
trephining of cornea in removal of melanosarcoma of 979
tumor of..... 995
Iritis, bacteriologic and immunologic aspects of iritis, with special reference to its relationship to bacterial allergy 670
rôle of traumatism in certain forms of iritis 660
Irradiated human embryos, rosette formation in eyes of..... 495

Jameson, P. C.: Schaaf forceps for removal of foreign bodies.....*802
Surgical treatment of squint; recession operation 993
Jaw-Winking phenomenon; another case of Marcus Gunn's phenomenon..... 971
John, I.: Disturbances of sensibility of cornea and conjunctiva in xerosis and keratomalacia of adults; with contribution to explanation of genesis of these diseases.....*374
Journal, quarterly journal on prevention of blindness, *Sight-Saving Review*..... 804
Ukrainian ophthalmological journal..... 461

Keratitis, case of..... 148
ephemeral form of..... 971
filamentous, new therapy in..... 986
histopathology of von Szily's scleroperikeratitis 970
lattice; 5 cases in 1 family..... 497
neuroparalytic, in hemianesthesia of opposite side..... 809
nodosa Groenouw, with histologic examination, 2 cases..... 298
postvaccinolosa *91, 298
reccurrent vascular keratitis of unknown origin 831
sclerosing 997
specific reactions in experimental tuberculous keratitis in rabbits..... 810
superficial punctate keratitis..... 470
tuberculous; fistula of cornea, repair... 832
ultraviolet therapy in herpetic keratitis. 665
Keratoconjunctivitis, relation between phlyctenular keratoconjunctivitis and tuberculosis 130
Keratoconus, case of keratoconus with Müller's contact lenses..... 672
contact glasses worn for 6 years in case of 471
family affected with keratoconus and anterior polar cataract..... 970

PAGE

Keratomalacia, disturbances of sensibility of cornea and conjunctiva in xerosis and keratomalacia of adults; with contribution to explanation of genesis of these diseases....*374
pigmentation of conjunctiva in normal individuals and in cases of keratomalacia in adults.... 647
Keratomes, trial exercises and new procedures in ocular surgery with two keratomes 979
Key, B. W.: Transplantation of human cornea, report of case....*789
Tuberculous keratitis; fistula of cornea; repair 832
Kidney disease, differentiation and significance of certain ophthalmoscopic pictures in hypertensive disease.... 811
disease, retinitis nephritica or albuminurica 984
Kirby, D. B.: Calcium in relation to cataract 496
Calcium in relation to cataract; in vitro *856
Calcium in relation to cataract; in vivo.*868
Senile cataract; use of parathyroid extract *754
Knapp, A.: Ernst Fuchs.... 288
Extraction of cataract; report of a third hundred successive extractions in capsule after preliminary subluxation with capsule forceps....*575
Kolmer, J. A.: Bacteriologic and immunologic aspects of iritis, with special reference to its relationship to bacterial allergy 670
Kronfeld, P. C.: Puncture of anterior chamber in glaucoma.... 673
Synergistic action of atropine and epinephrine on intrinsic muscles of eye..*212
Krukenberg's spindle....808, 996
Kuhn, H. S.: Hereditary optic atrophy (Leber's disease); clinicosurgical study *408

Lacrimal Organs; adenocarcinoma of lacrimal gland.... 485
clinical and experimental investigations on lysozyme content in tears and conjunctival secretion 138
continued investigation on lacrimal passages 302
treatment of congenital dacryocystitis... 975
Laevoglaucosan, two per cent epinephrine solutions as substitutes for....*350
Lagrange operation, modified Lagrange operation in glaucoma.... 669
Law, F.: Local absence of stroma of iris 148
Retinal pigmentation 148
Traumatic zonular cataract.... 148
Lebensohn, J. E.: Nystagmus of ocular origin *638
Leber's Disease: See Nerve, Optic
Lens, Crystalline; biochemical investigation of nitrogen, weight and water content of crystalline lenses....*623
case of luxated lens in anterior chamber 475
chemical studies of lipids of normal animal lenses, cataractous human lenses and blood of patients with cataract..*354
colored crystals on anterior surface of lens affected by senile cataract.... 653
myopia caused by microphakia.... 474
reflections on biomicroscopy of.... 653
Light sense....479, 656
Lillie, W. I.: Chiasmal syndrome produced by chronic local arachnoiditis; report of 8 cases....*558
Lindau, A.: Vascular tumors of brain and spinal cord (neurologic standpoint).. 316

PAGE

Lipemia retinalis.... 308
Lipids, chemical studies of lipids of normal animal lenses, cataractous human lenses and blood of patients with cataract *354
Lipoid, distribution of lipoid in Niemann-Pick's disease associated with amaurotic family idiocy.... 815
histiocytosis or xanthomatosis....*29
Liver therapy in ocular lesions of true and pseudo-pernicious anemia.... 665
Lloyd, R. I.: Herpes and allied conditions 499
Proptosis as a diagnostic problem.... 834
Lourie, O. R.: Focal infection, an etiologic factor in eye diseases....*893
Lysozyme, clinical and experimental investigations on lysozyme content in the tears and conjunctival secretion.... 138

McAndrews, L. F.: Intracapsular cataract extraction, its present status.... *93
Retinal detachment; method of accurately localizing tears....*760
MacCallan, A. F.: Episcleritis due to focal sepsis 828
McKeown, H. S.: Osseous tumors of orbit *449
Macula, anatomy of sickle-shaped degeneration of macular region in retina.. 823
familial macular degeneration.... 996
hemorrhage 829
Niemann-Pick's disease with cherry-red spots in....506, *704
ocular pathology of Niemann-Pick's disease with cherry-red spot in macula.. 506
progressive bilateral lesions of macula in young subjects (disease of Stargardt) 821
Malaria, ocular complications of.... 474
Malingering, test types for estimating with Worth's amblyoscope the vision of malingerers *918
Marshall, C.: Sclerosing keratitis.... 997
Mastication, functional synergy of mastication and elevation of upper eyelid. 307
Mayou, M. S.: Shrunken stump.... 828
Meibomian gland, case of epithelioma of meibomian gland.... 313
Melanoma of conjunctiva.... 990
origin of malignant melanoma of tunica conjunctiva 146
Melanosarcoma of iris, trephining of cornea in removal of.... 979
prognosis in enucleation for melanosarcoma of uvea.... 145
routes of extra-ocular extension of melanosarcoma of choroid.... 145
Meningitis, eye observations in.... 815
Menstruation, glaucoma with premenstrual exacerbations 812
Mercurochrome in ocular diseases.... 662
Microphakia: See under Lens, Crystalline
Microphthalmos, case of.... 648
Migraine, anatomic and clinical proof of mechanism of hypophysis in ophthalmic migraine and ophthalmoplegic migraine. 305
Mikulicz's Disease and Mikulicz's syndrome, treatment by irradiation.... 810
case of Mikulicz's disease.... 300
Mole, retinal.... 996
Moore, R. F.: Cataract from exposure to roentgen rays.... 681
Glioma of retina.... 996
Morgan, G.: Conjunctivitis.... 678
Müller's Contact Glasses: See under Contact Glasses
Muscles, operations on muscles, with special reference to tucking method.... 489
synergistic action of atropine and epinephrine on intrinsic muscles of eye...*212
Myasthenia, ocular symptoms in a case of myasthenia with tumor of thymus..... 811
Myiasis, ocular.... 981

PAGE

Myopia, continued criticism of origin of myopia 308
discussion of elements underlying progressive axial myopia..... 820
mechanism of detachment of retina in.... 483
topography of margin of disk in myopic and nonmyopic eyes..... 129
Myxoma, multiple, of orbit; later note.....*445

Naphthalene, study of correlation between biochemical and intraocular changes induced in rabbits by..... 471
Neame, H.: Retinal detachment..... 997
Nerve, nasociliary, multiple neurofibromas of *800
oculomotor, paralysis of, with unusual symptoms 816
optic atrophy with retinal changes caused by high-tension current..... 658
optic; chronic cisternal arachnoiditis producing symptoms of involvement of optic nerves and chiasm; pathology and results of operative treatment in 4 cases.*334
optic; extension of glioma (retinoblastoma) into optic nerve.....*269
optic, frequency of Leber's disease among females 141
optic, hereditary optic atrophy (Leber's disease); clinicosurgical study of case..*408
optic; microscopic demonstration of tissue formations on optic nerve head..... 990
optic; multiple abscesses in both optic nerves caused by streptococcic sepsis...*659
optic; stereoscopic photographic demonstration of tissue formations on optic nerve head..... 991
optic, treatment with atropine in atrophy of 986
Neuritis, relation of paranasal sinuses to ocular disorders; especially to retrobulbar neuritis.....*276
retrobulbar, masked by choroiditis and due to latent sinusitis..... 830
Neurofibromas, multiple neurofibromas of nasociliary nerve.....*800
Nevus, buphthalmos with facial naevus and allied conditions..... 137
histogenesis of nævus pigmentosus of conjunctiva and lids..... 486
melanotic nevus of eye..... 504
recurrent pigmented nevus of conjunctiva. 505
Niemann-Pick's Disease, distribution of lipoid in Niemann-Pick's disease associated with amaurotic family idiocy..... 815
ocular pathology of Niemann-Pick's disease with cherry-red spot in macula... 506
with cherry-red spots in macula.....*704
Night-blindness: See Hemeralopia
Nose and throat in relation to orbital and ocular disease..... 307
diseases of paranasal sinuses and their relations to disorders of eye..... 488
relation of paranasal sinuses to ocular disorders; especially to retrobulbar neuritis *276
retrobulbar neuritis masked by choroiditis and due to latent sinusitis..... 830
Nystagmus, fields of vision in miners' nystagmus 146
latent 815
of ocular origin.....*638
spontaneous, in congenital syphilis..... 978

Obituaries:

Fuchs, Ernst, 1851-1930..... 288
Gullstrand, Allvar, 1862-1930..... 294
Theobald, Samuel, 1846-1930..... 463
Thomson, E. S., 1871-1931..... 469
Woods, Hiram, 1857-1931..... 466
O'Brien, C. S.: Behavior of vitreous under different hydrogen and hydroxyl ion concentrations; study in vitro.....*903
Occupational poisons in New York during 1930 968
Occupations, investigation into effect upon eyes of occupations involving close work 481

PAGE

O'Connor, R.: Ocular tendon transplantations; 3 new methods.....*209
Olitsky, P.: Trachoma..... 502
Ophthalmia neonatorum, prophylaxis of... 969
neonatorum, vaccinotherapy in..... 147
sympathetic; experimental studies of tuberculotoxic etiology of sympathetic ophthalmia (Guillery)..... 972
sympathetic, frequency of..... 661
sympathetic; researches on its pathogenesis and observations on 2 cured personal cases..... 662
sympathetic; unassociated with perforation or rupture of eyeball.....*781
Ophthalmic Examinations, American Board for.....646, 804
Ophthalmologic societies, directory of..... .....155, 320, 511, 685, 843, 1001
Ophthalmology, instruction in ophthalmology in hospitals of Paris..... 645
new research institute and hospital..... 646
post-graduate courses.....461, 967, 968
progress in medical and in surgical treatment in ophthalmology, 1929-1930.....*948
rectal narcosis in ophthalmic surgery.... 473
Ophthalmoplegia, complete bilateral congenital exterior ophthalmoplegia and double ptosis; bilateral cerebral cortical atrophy of frontal and parietal regions (encephalograms) *15
Ophthalmoscope, localizing, for Gonin operative procedure in reattachment of retina 142
Optic Chiasm, chiasmal syndrome produced by chronic local arachnoiditis; report of 8 cases.....*558
chronic cisternal arachnoiditis producing symptoms of involvement of optic nerves and chiasm.....*334
lesions of chiasmal region..... 146
Optic Disk, case of crater-like hole in.... 131
cupped disks and binasal hemianopia... 996
topography of margin of disk in myopic and nonmyopic eyes..... 129
Optic Nerve: See Nerve, optic
Orbit, angioma venosum of..... 833
congenital anophthalmos with orbitopalpebral cyst.....*884
cylindroma of..... 485
examination of contents of orbit exenterated for retrobulbar sarcoma..... 486
granuloma invading orbit due to aspergillus, 2 cases..... 477
hydatid cysts of, extirpation by subaponeurotic orbitotomy..... 477
multiple myxoma of orbit; later note....*445
nose and throat in relation to orbital and ocular disease..... 307
osseous tumors of.....*449
rodent ulcer extending into..... 149

Paget's Disease of Bone: See Osteitis deformans
Papilledema and intra-ocular tension..... 824
genesis of..... 823
importance of choked disk in diagnosis between epidemic encephalitis and cerebral tumor..... 305
in experimentum crucis hominis..... 142
incongruities between choked disk and causative condition..... 310
unilateral angiospastic paralysis of fourth nerve with bilateral choked disk following fall on back of head..... 649
Paralysis of oculomotor nerve with unusual symptoms 816
unilateral angiospastic paralysis of fourth nerve with bilateral choked disk following fall on back of head..... 649
Parathyroid extract in senile cataract.....*754
Paton, L.: Tumor of iris..... 995
Peripheral field of vision, refraction of....*717
Peter, L. C.: Advancement and other shortening operations for concomitant squint 993
Pfahler, G. E.: Roentgen therapy in pituitary tumors..... 825

PAGE

Phelan, H. V.: Multiple neurofibromas of nasociliary nerve *800
Phlyctenulosis, and its relation to tuberculosis 647
Phototherapy, contribution to 664
Pigmentation, of conjunctiva in normal individuals and in cases of keratomalacia in adults 647
Pituitary Body, anatomic and clinical proof of mechanism of hypophysis in ophthalmic migraine and ophthalmoplegic migraine 305
tumor of pouch of Rathke 475
tumors, ophthalmologic aspects of 827
tumors, roentgen therapy in 825
tumors, surgical treatment of 826
Poisons, occupational, in New York during 1930 968
Postcycloplegic test *943
Postgraduate course, eighth postgraduate course in ophthalmology, Vienna, 1931 461
in ophthalmology in Chicago 968
summer graduate course in ophthalmology at Rochester 967
Pregnancy, cause and relation of retinitis and detachment in 823
Pressure: See Tension
Preston, F. E.: Color blindness 679
Prize in ophthalmology 804
international trachoma prize 646
Projection and binocular vision *734
Proteins, experimental investigation concerning action of foreign proteins on normal eye 472
Provaczek-Halberstadter inclusion bodies and their clinical significance 142
Prurigo, spring catarrh and Hebra's prurigo 648
Pterygia, electrocoagulation of *732
Ptosis: See Eyelid
Pupilloscope, resistance 974
Pupils, Argyll Robertson phenomenon 478
emotional reaction of pupil 478
misleading position of pupils in normal eyes 817

Quadrigeminate plate, tumors of quadrigeminate plate; clinico-anatomic study of 7 cases *418
Quinine amblyopsia, experimental study of. 135

Radiant energy, injuries of eye caused by .. 814
Rand, G.: Refraction for peripheral field of vision *717
Sensitive methods for detection of Bjerrum and other scotomas *224
Randel, H. O.: Squint; its physiopathology and surgical treatment *691
Rathke, Pouch of: See under Pituitary Body
Reese, A. B.: Extension of glioma (retinoblastoma) into optic nerve *269
Refraction curve 140
estimation of total refractive error without aid of cycloplegia 493
for peripheral field of vision *717
great practical importance of bicylindric combinations in determination of refraction 657
in twins: anisometropia and corneal refraction; modification of corneal refraction; corneal astigmatism and corneal refraction 982
investigation into effect on eyes of occupations involving close work 481
postcycloplegic test *943
Retina, anatomy of sickle-shaped degeneration of macular region in 823
angioid streaks of 985
benign retinal changes 311
cause and relation of retinitis and detachment in pregnancy 823
changes in retina in patients with renal disorders 311
crystalloids in human retina 969
detached, secondary glaucoma with detached retina in both eyes *55
detachment 310, 822, 997

Retina—Continued PAGE
detachment, apparent cure following Gonin operation 988
detachment, cholesterol crystals in subretinal fluid of an atypical detachment 822
detachment in myopia, mechanism of 483
detachment in new-born, 2 cases 821
detachment, localizing ophthalmoscope for the Gonin operative procedure in reattachment of retina 142
detachment: method of accurately localizing tears *760
detachment; operative treatment of detachment of retina with electro-endothermy and trephining 311
detachment, retinitis proliferans complicated by 829
detachment, review of some recent literature *784
detachment, scleroretinal cauterization in 821
glioma of 996
gliomas of retina, including results of studies with silver impregnations *920
moles 996
pigmentation 148
tears, closure of 309
test for retinal function in cataractous patients *636
of vitamin A in retinal tissue 675
Retinitis albuminurica, significance of arteriosclerosis on retina, choroid and optic nerve in pathogenesis of retinitis albuminurica 141
blood calcium in diabetic retinitis 309
cause and relation of retinitis and detachment in pregnancy 823
circinata, pathogenic anatomy of 141
early diabetic retinitis 149
hereditary color blindness and changes in macula: case of total color blindness coupled with retinitis pigmentosa 130
nephritica or albuminurica 984
pigmentosa, etiology of 658
pigmentosa, microscopic observations in. *392
proliferans complicated by retinal detachment 829
tuberculous, treated with a new Japanese polyvalent tuberculosis vaccine, 3 cases 985
Retinoblastoma, extension of glioma (retinoblastoma) into optic nerve *269
its recognition when fundus oculi is obscured *890
Robinson, G. A.: Multiple epidermoid carcinoma of eye and lid *936
Recurrent epidermoid carcinoma 671
Roentgen rays, cataract from exposure to x-rays 681
lesions of eye caused by energy of emanating rays 972
rosette formation in eyes of irradiated human embryos 495, *591
therapy in pituitary tumors 825
Rones, B.: Ocular lesions in septicemia ... *175
Rosenbaum, M.: Congenital anophthalmos with orbitopalpebral cyst *884
Rosette formation in eyes of irradiated human embryos 495, *591
Royer, B. F.: Health of eyes in Philadelphia 314
Rutherford, C. W.: Progress in medical and surgical treatment in ophthalmology, 1929-1930 ..... *948

Salit, P. W.: Behavior of vitreous under different hydrogen and hydroxyl ion concentrations; study in vitro *963
Biochemical investigation of nitrogen, weight and water content of crystalline lenses *623
Chemical studies of lipids of normal animal lenses, cataractous human lenses and blood of patients with cataract ... *354
Samuels, B.: Ernst Fuchs 290
Microscopic demonstration of tissue formations on optic nerve head 990

PAGE

Sarcoma, examination of contents of orbit exenterated for retrobulbar sarcoma.. 486
palpebral complication in a case of Kaposi's sarcomatosis..... 977
primary sarcoma of iris; removal by iridectomy; no recurrence in 3½ years..*219
ring sarcoma of iris..... 144
Schaaf forceps for removal of foreign bodies *802
Schlemm, canal of, development and morphology of canal of Schlemm..... 296
Schwartz, V. J.: Intra-ocular blastomycosis *581
de Schweinitz, G. E.: Complete bilateral congenital exterior ophthalmoplegia and double ptosis; bilateral cerebral cortical atrophy of frontal and parietal regions (encephalograms) *15
Sclera, episcleritis due to focal sepsis... 828
family tree of blue sclerotics and theory of its transmission..... 134
histopathology of von Szily's scleroperikeratitis 970
localization through sclera of ophthalmoscopic lesions..... 977
pigmented cells in sclera of vertebrates.. 296
total ectasia of..... 990
Scleroperikeratitis, histopathology of von Szily's scleroperikeratitis..... 971
Scotomas, sensitive methods for detection of Bjerrum and other scotomas.....*224
Septicemia, ocular lesions in.....*175
Shumway, E. A.: An emergency kit for ophthalmic examinations and treatments 666
Sight-Saving: See under Vision
Sinaiko, A. A.: Keratitis postvaccinolosa.. *91
Sinuses, Paranasal: See under Nose
Sitchevska, O.: Case of keratoconus with Müller's contact lenses..... 672
Sloan, L. L.: Paracentral field in early glaucoma *601
Sensitive methods for detection of Bjerrum and other scotomas.....*224
Smallpox, vaccinial keratitis.....*91, 298
Smith, D.: Estimation of total refractive error without aid of cycloplegia..... 493
Smith, H. G.: Squint; its physiopathology and surgical treatment.....*691
Smith, J. W.: Melanoma of conjunctiva... 990
Recurrent pigmented nevus of conjunctiva 505
Total ectasia of sclera..... 990
Social service at Massachusetts Eye and Ear Infirmary..... 508
Societies, Colorado Congress of Ophthalmology and Oto-Laryngology..... 967
First Congress of Ophthalmology of Latin America 645
foreign, directory of.....
.....155, 320, 511, 685, 843, 1001
fourteenth International Ophthalmologic Congress.....127, 645
local, directory of.157, 323, 513, 687, 845, 1003
national, directory of.....
.....155, 320, 511, 685, 843, 1001
New York State Medical Society, meeting of 806
Ophthalmological Society of United Kingdom, meeting..... 805
Oxford Ophthalmological Congress..... 968
Second International Hospital Congress.. 645
sectional, directory of.....
.....155, 320, 511, 685, 843, 1001
state, directory of.....
.....156, 321, 512, 686, 844, 1002

Society Transactions:
College of Physicians of Philadelphia, Section on Ophthalmology...314, 666, 825
New York Academy of Medicine, Section of Ophthalmology...504, 671, 832, 988, 993
Royal Society of Medicine, Section on Ophthalmology.....148, 828, 995
Spackman, E. W.: Roentgen therapy in pituitary tumors..... 825

PAGE

Spectacles: See Glasses
Spinal Cord, vascular tumors of brain and spinal cord (neurologic standpoint).... 316
vascular tumors of brain and spinal cord (ocular manifestations)..... 316
Sporothrix infection of eye and adnexa.... 494
Sporotrichosis of bulbar conjunctiva..... 970
Staining, vital staining of posterior segment of globe..... 818
Stargardt, disease of, progressive bilateral lesions of macula in young subjects... 821
Strabismus, advancement and other shortening operations for concomitant squint 993
occluder for squint..... 140
operations on muscles with special reference to tucking method..... 489
physiopathology and surgical treatment..*691
prism glasses in early stages of..... 476
recession operation..... 993
surgical treatment of..... 993
Streptococcus, multiple abscesses in both optic nerves caused by streptococcic sepsis 659
Stucky, J. A.: Trachoma..... 502
Stump, shrunken..... 828
Suprarenal preparations, synergistic action of atropine and epinephrine on intrinsic muscles of eye.....*212
two per cent epinephrine solutions as substitutes for laevoglaucosan.....*350
Swett, W. F.: A new operative procedure in glaucoma *634
Syphilis, congenital, spontaneous nystagmus in 978
diseases of cornea in acquired syphilis... 133
primary, of eyelid..... 139
rare forms of hereditary syphilis affecting eye alone..... 136

Taggart, J. H.: Retinitis proliferans complicated by retinal detachment..... 829
Tarsectomy, simple tarsectomy, indications and technique..... 654
Tay-Sachs-Schaeffer disease, histopathology 491
review of disease and allied conditions.. 491
Tears, clinical and experimental investigations on lysozyme content in tears and conjunctival secretion..... 138
Tendon, ocular tendon transplantations; 3 new methods.....*209
Tension, alkaline reserve of blood and intra-ocular tension..... 974
behavior of vitreous under different hydrogen and hydroxyl ion concentrations *903
experiments on hypotonia caused by contusion in rabbits..... 471
experiments on variations in tension of eye produced by vascular drugs..... 649
intra-ocular, and papilledema..... 824
intraocular pressure and drainage of aqueous humor..... 818
properties of external ocular coats at abnormal intra-ocular pressures..... 299
Test types for estimating with Worth's amblyoscope the vision of malingerers..*918
Throat and nose in relation to orbital and ocular disease..... 307
Thrombosis, cranial sinus, ophthalmologic aspects of..... 816
of branch of central retinal vein..... 677
Thygeson, P.: Bacterium granulosis in trachoma *527
Thymus tumor with myasthenia, ocular symptoms in 811
Town, A. E.: Cyst of iris..... 833
Trachoma 501, 502
bacterium granulosis in trachoma.....*527
bacterium granulosis in relation to trachoma; recovery from experimentally infected monkeys and from human trachoma 312
control of..... 142
cytology of conjunctiva in trachoma and significance of its pathogenesis..... 144

Trachoma—Continued PAGE
does acute trachoma exist?..... 824
in wrestlers..... 666
international trachoma prize..... 646
Provaczek-Halberstadter inclusion bodies and their clinical significance..... 143
Public Health circular on eradication and prevention of..... 804
spread of trachoma and campaign against it 484
therapy 312
trachomatous bodies of Bonnet and perilimbic corneal follicles of trachomatous pannus 824
rôle of traumatism in certain forms of iritis 660
Trephine operation; pressure and dirt in this operation, with new devices for control *517
Tuberculosis of eye..... 980
clinical study of 16 cases of ocular tuberculosis 980
eye in tuberculous patient..... *66
of eyeball and adnexa in Egypt..... 981
phlyctenulosis and its relation to tuberculosis 647
relation between phlyctenular keratoconjunctivitis and tuberculosis..... 130
tuberculous iridocyclitis, diagnosis..... 968
tuberculous retinitis treated with a new Japanese polyvalent tuberculosis vaccine, 3 cases..... 985
typical and atypical ocular tuberculosis.. 650
Tularemia, oculoglandular (Parinaud's conjunctivitis) 470
Tumor: See also Cancer; Sarcoma, etc.
importance of choked disk in diagnosis between epidemic encephalitis and cerebral tumor..... 305
ocular symptoms in myasthenia with tumor of thymus..... 811
of brain, operations and their results.... 476
of brain, ophthalmologic experiences in care of 474
of iris 995
of orbit, osseous..... *449
of pouch of Rathke..... 475
of quadrigeminate plate; clinicoanatomic study of 7 cases..... *418
pituitary, ophthalmologic aspects of.... 827
pituitary, roentgen therapy in..... 825
pituitary, surgical treatment of..... 826
progressive exophthalmia due to new growth in frontal lobe..... 654
vascular tumors of brain and spinal cord, (neurologic standpoint)..... 316
vascular tumors of brain and spinal cord (ocular manifestations)..... 316
Twins, refraction in: anisometropia and corneal refraction; modification of corneal refraction; corneal astigmatism and corneal refraction..... 982

Ulcer, rodent ulcer extending into orbit.. 149
treatment of serpiginous ulcer of cornea by means of iontophoresis with ethyl hydrocuprein hydrochloride..... 133
Ultrared rays, lesions of eye caused by energy of emanating rays..... 971
Ultraviolet rays, lesions of eye caused by energy of emanating rays..... 971
therapy in herpetic keratitis..... 665
Urine, sugar; relation between hyperglycemia and glycosuria in experimental diabetes and in clinical cases with ocular changes..... 135
Uvea, prognosis in enucleation for melanosarcoma of uvea..... 145
Uveo-parotid fever, a case of..... 660

Vail, D. T., Jr.: Chronic cisternal arachnoiditis producing symptoms of involvement of optic nerves and chiasm; pathology and results of operative treatment in 4 cases..... *334

PAGE
Verhoeff, F. H.: Microscopic observations in case of retinitis pigmentosa.....*392
Vision, anaglyphic stereoscopic vision.... 657
binocular vision and projection.....*734
conference on conservation of..... 128
conservation, résumé of special inquiry on health of eyes in Philadelphia.... 314
courses for teachers of sight-saving classes 968
entoptic phenomena..... 150
light sense.....479, 656
test types for estimating with Worth's amblyoscope the vision of malingerers.*918
what indications must be met by scale of visual acuity 660
Vitamin A, presence of vitamin A in retinal tissue 675
Vitreous, behavior of vitreous under different hydrogen and hydroxyl ion concentrations; study in vitro.....*903

Walker, C. B.: Trephine operation; pressure and dirt in this operation, with new devices for control.....*517
Weiss, C.: Trachoma..... 502
Wexler, D.: Niemann-Pick's disease with cherry-red spots in macula.....*704
Ocular pathology of Niemann-Pick's disease with cherry-red spot in macula... 506
Rosette formation in eyes of irradiated human embryos.....495, *591
Wheeler, J. M.: Exophthalmos associated with diabetes insipidus and large defects in bones of skull.....*161
White House Conference on Child Health and Protection..... 645
Whiting, M. H.: Cataract after an electric flash 996
Cupped disks and binasal hemianopia.... 996
Iridocyclitis 997
Wilder, W. H.: Secondary glaucoma with detached retina in both eyes..... *55
Williams, T. A.: Mechanism of some convulsive movements of orbicularis and of face; manner of their removal.....*272
Wilmer, W. H.: Hiram Woods, 1857-1931... 466
Winkleman, N. W.: Tay-Sachs-Schaeffer disease; histopathology..... 491
Wolfe, O. R.: Modified Barraquer cataract operation 498
Wolff, E.: Macular hemorrhage..... 829
Rodent ulcer extending into orbit..... 149
Wolff, J.: Apparent cure of serous detachment following the Gonin operation.... 988
Wootton, H. W.: E. S. Thomson, 1871-1931 469
Worth's amblyoscope; test types for estimating with Worth's amblyoscope the vision of malingerers.....*918
Wrestlers, trachoma in..... 666

Xanthomatosis or lipoid histiocytosis; report of ocular observations in 2 cases of Christian's syndrome: a correlation with other ocular syndromes..... *29
Xerophthalmia, clinical and histologic picture of epithelial xerosis of conjunctiva 131
disturbances of sensibility of cornea and conjunctiva in xerosis and keratomalacia of adults; with contribution to explanation of genesis of these diseases.....*374
in rats and "periocular reaction"..... 300
prexerosis and xerosis corneae in adults.. 134
Xerosis: See Xerophthalmia

Yudkin, A. M.: Presence of vitamin A in retinal tissue..... 675

Zentmayer, W.: Primary sarcoma of iris; removal by iridectomy; no recurrence in 3½ years.....*219
Trachoma in wrestlers..... 666
Zubak, M. F. C.: Electrocoagulation of pterygia *732